AUGUST 1950

POWER

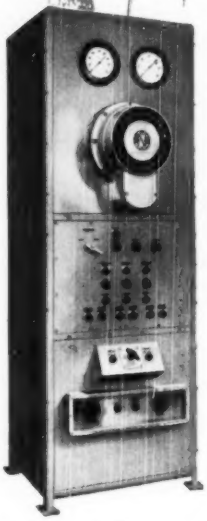
A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

TOPS IN INDUSTRIAL POWER? See what you think when you read about Dow Chemical's 100% cyclone-fired plant, p 74 • CONTENTS, p 69

PERFECT TIMING

SAVES DUST MONEY

The Hydrovac Automatic System takes the guesswork out of dust handling. Under automatic control, the sequencing from one valve to the next is entirely responsive to the loading in the hopper. As soon as a hopper is empty, its valve closes, and no time is wasted moving to the next. And, more important savings are effected through eliminating wear on the system from sandblasting by high-velocity air lightly laden with dust.



It's the Automatic Sequence Head that effects perfect timing. Started with one pushbutton, it opens and closes dust valves, skips boilers off the line, warns of unusual conditions by ever telling what is happening, and closes the system when all dust is removed. It enables the Hydrovac System to save enough in operating time, attendance, and maintenance to pay for itself in a surprisingly short time.

Ask us for the complete story, or write for our catalog today.

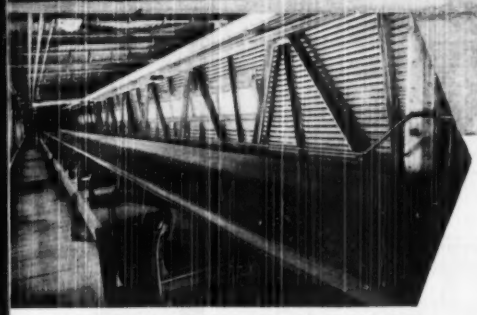
This is the Automatic Sequence Head — the "brain" that directs the perfect A-S-H System.

COMPLETELY AUTOMATIC
HYDROVAC dust handling system

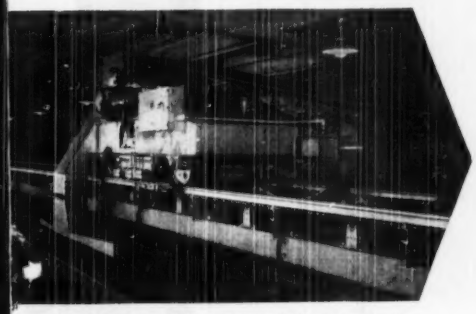
ALLEN-SHERMAN-HOFF CO., 227 S. 15th ST., PHILADELPHIA 2, PA. *Offices & Representatives in Principal Cities*

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," "The Industrial Engineer"), August, 1950, Vol. 94, No. 8. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Editorial and executive offices, 330 W. 42nd St., New York 18, N.Y. Entered as second class matter January 26, 1949, at the post office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least 10 days for change of address. Subscription rates, U. S. and U. S. possessions, $5 for one year, $7 for two years, 45c per single copy. Canada $7 for one year, $11 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years. Please indicate position and company connection on all subscription orders.

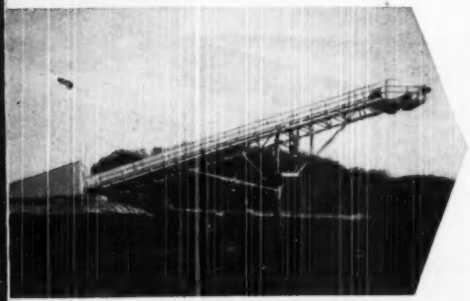
1 then 2 and now 3



The 36" wide belt conveyor in the gallery for delivering the coal to the bunkers.



View of the coal conveyor over the bunkers showing a close-up of the Link-Belt motor-driven tripper that controls the distribution of the coal; also the plow on the discharge chute for opening and closing the bin seals that confines the dust to the bins.



The yard-storage belt conveyor delivers the coal from the reversible belt conveyor below the hopper-car track to the yard.

Indianapolis Power & Light Company Repeats Again with LINK-BELT Coal-Handling Equipment for Third Station

(WHITE RIVER GENERATING STATION)

Link-Belt equipment and engineering with Link-Belt coal-handling "know how" worked out so well for Indianapolis Power & Light Company at two other stations, that when it came to equipping the newest station, it was Link-Belt again.

Coal arrives at this station in hopper cars from which it is discharged through a reciprocating feeder to the reversible belt conveyor under the hopper track. At one end is a conveyor that delivers the coal to the storage yard; at the other end is the conveyor that terminates at the crusher house, where it is screened and tramp iron removed by a magnetic pulley. It then goes to a belt conveyor that extends over the bunkers. The distribution to the bunkers is handled by a Link-Belt motor-driven tripper. The tripper chute is equipped with a plow that opens and closes the bin seals so that the dust is confined to the bins.

The handling capacity of this Link-Belt installation is 400 tons an hour.

Every Link-Belt coal-handling installation is an example of efficiency and economy engineered to meet particular conditions. If you have a coal-handling problem, either in a public utility or industrial power plant, Link-Belt "know how" will be a big help in finding the way out. Ask our nearest office.

LINK-BELT

COAL and ASHES HANDLING EQUIPMENT

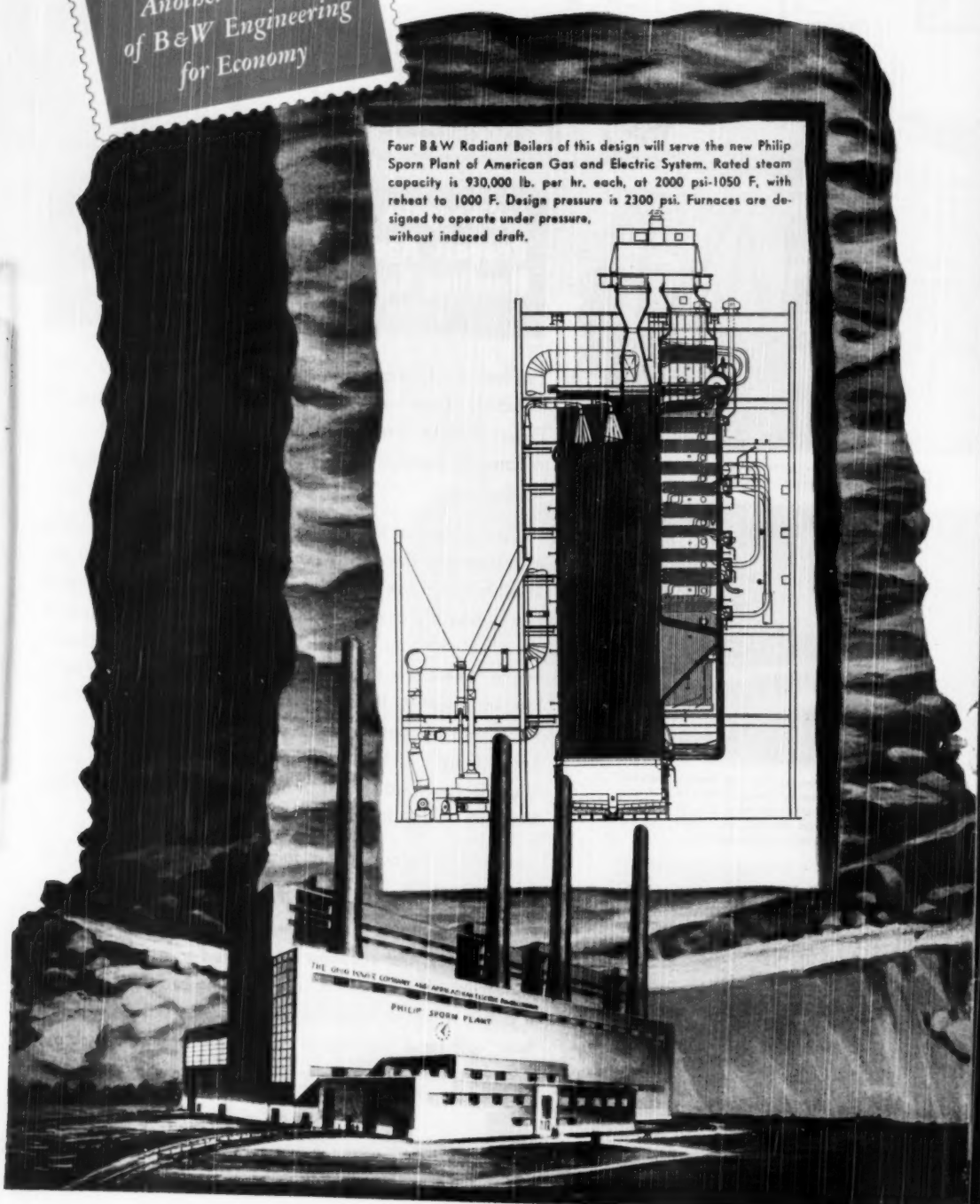
LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

12,010

Another Example of B&W Engineering for Economy

Four B&W Radiant Boilers of this design will serve the new Philip Sporn Plant of American Gas and Electric System. Rated steam capacity is 930,000 lb. per hr. each, at 2000 psi-1050 F, with reheat to 1000 F. Design pressure is 2300 psi. Furnaces are designed to operate under pressure, without induced draft.



A NEW Milestone

IN EFFICIENT POWER GENERATION

First of its kind, the new Philip Sporn Plant of American Gas and Electric System has the lowest station heat-rate in steam-electric generating history. Utilizing reheat and the highest pressure-temperature combination ever employed throughout an entire central station, its four B&W Radiant Boilers will supply all the steam required for 600,000 new kw. of electric-generating capacity.

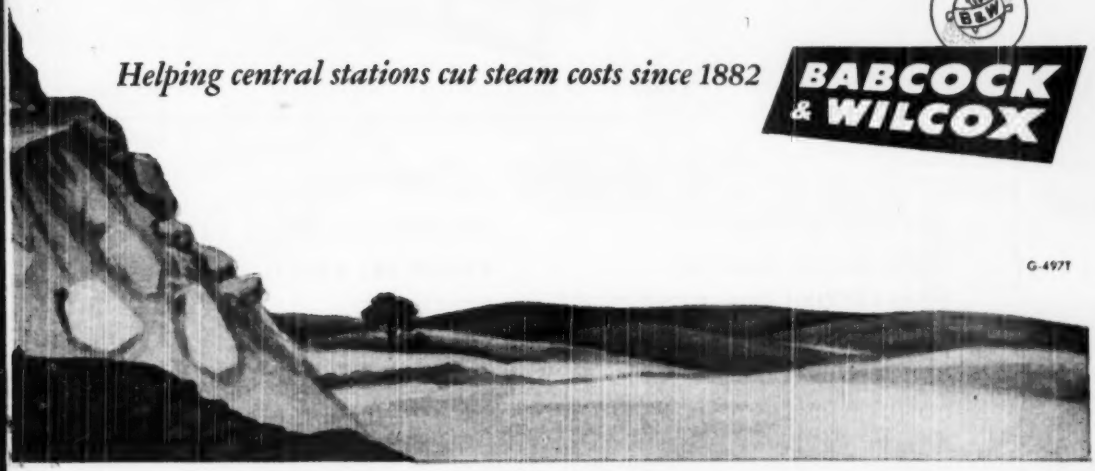
Setting records in power generating efficiency is an old story with American Gas and Electric. And *helping* to set them, through cooperation with this utility's far-sighted and courageous management, is an old story with B&W.

As the search continues for still more and better ways to keep power costs down, B&W will continue, in cooperation with power companies, to apply the advanced thinking and research that have produced so many other notable milestones in the steady advance toward today's highly efficient, economical power generation.

Helping central stations cut steam costs since 1882

BABCOCK & WILCOX

G-4971



You're a step ahead

the deaerating heater that makes unnecessary the tubular vent condenser
the outdoor motor that laughs at wet weather
the high pressure turbocharger that further boosts diesel power

The Elliott Line-up

TURBINE-GENERATORS
DEAERATING HEATERS
GENERATORS FOR DIESELS, ETC.
TURBOCHARGERS FOR DIESELS
CENTRIFUGAL BLOWERS
CONDENSERS
MECHANICAL DRIVE TURBINES
STEAM JET EJECTORS
STRAINERS
TUBE CLEANERS
MOTORS—(Integral, Crocker Wheeler Div.)
(Large, Ridgway Div.)

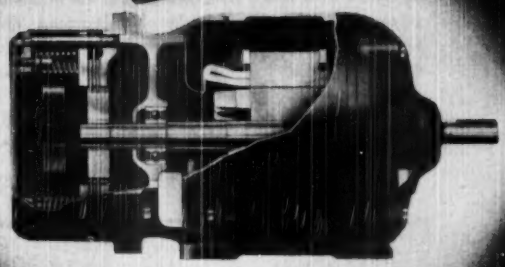
with... ELLIOTT

Getting the jump on the field has become a tradition with Elliott engineers. As for instance in the development of heavy, high-speed centrifugal blowers . . . the pioneering of deaeration and the development of its equipment . . . the initiating of an entirely new technique as applied to the fabricating of steel in large motors and generators . . . the skillful designing of a turbine line which brings the advantages of standardization to practically any special application . . . the recognition of supercharger possibilities for diesels, and the combining of Elliott skills in the development of a highly successful turbocharger.

These, and other similar achievements make the big "E" in the familiar trade mark symbolize Exceptional Excellence in Engineering, as well as the name ELLIOTT.

the mechanical drive turbine that makes standardization flexible

the brake motor that sets new standards in high performance and low maintenance



Q-1148

ELLIOTT COMPANY

JEANNETTE, PA.

PLANTS AT:
JEANNETTE, PA.
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NEWARK, N. J.
DISTRICT OFFICES
IN PRINCIPAL CITIES

The ADVANTAGES of *Automatic Operation* ARE NOW AVAILABLE TO

Manually Operated

DIAMOND G9B SOOT BLOWERS

By means of a simple field change and the addition of power air, any manually operated Diamond Model G9B Soot Blower can be converted to automatic (air) operation. The sheave wheel, chain guide and chain of the manually operated blower are removed and replaced by the air control assembly and gear guard as shown at the right.

The converted G9B blower is set in operation simply by opening a valve at the blower; the unit then automatically goes through the preselected blowing cycle and stops. The valve is then closed manually. By addition of a control panel, full automatic SEQUENTIAL blowing is available.

The Diamond Model G9B is the most widely used of all soot blowers. This permanently installed (multi-nozzle element) steam blower of proven dependability has numerous outstanding features. Included are cam and trigger valve operation, flexible element connection and adjustable pressure control. To these can now be added the many advantages of automatic or automatic sequential operation at moderate cost. Conversion takes little time in the actual changeover, and the blowers are not removed from the boiler wall. Get in touch with the nearest Diamond office for further information or write directly to us at Lancaster, Ohio.

Diamond Short Retracting and Long Retracting Soot Blowers that are Manually Operated also can be Converted to Automatic Operation in the Field.

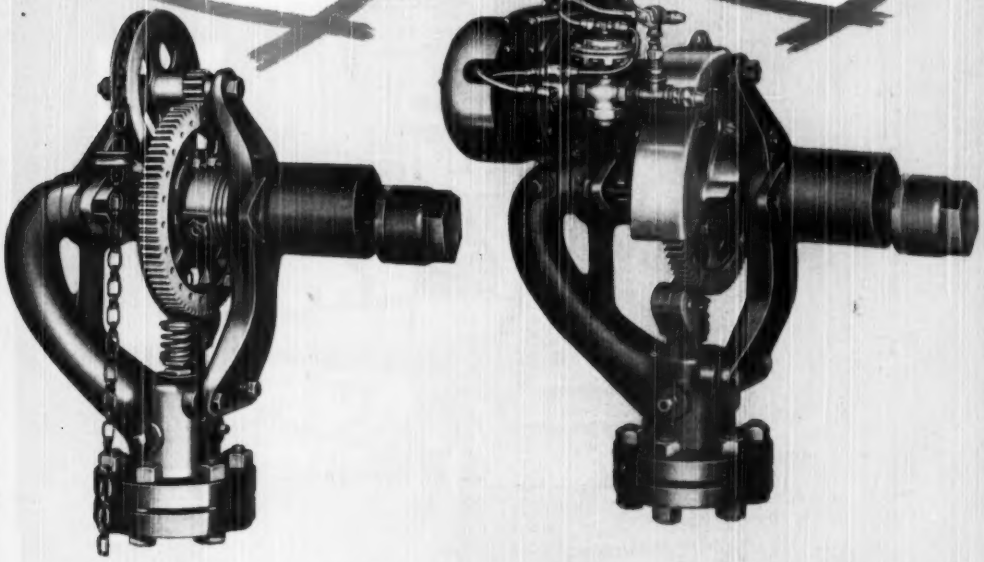
• *WRITE FOR INFORMATION*

DIAMOND POWER

CONVERSION IS EASY IN THE FIELD

Before CONVERSION

After CONVERSION



Manual Operation

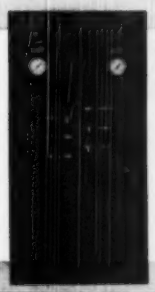
Operator opens valve in steam line . . . then pulls the chain that opens and closes the valve in head and simultaneously rotates the element. His time and attention are required throughout operation.

Automatic Operation

The operator simply opens a valve . . . the automatic air control then takes over and assures correct cleaning every time.

Automatic SEQUENTIAL Operation Requires only the Addition of a Control Panel

Any number of Model G9B Soot Blowers converted to automatic operation can be used in an automatic sequential system by the addition of a Diamond Control Panel. Other types of blowers can also be included in the system. The operator simply moves the start and stop valve carrier to the down position and then goes about his other duties. Traveling upward it operates each selected unit or group in turn . . . shuts off when all cleaning cycles are completed. It shows at a glance the units in operation and those that have operated. No electrical connections whatever.

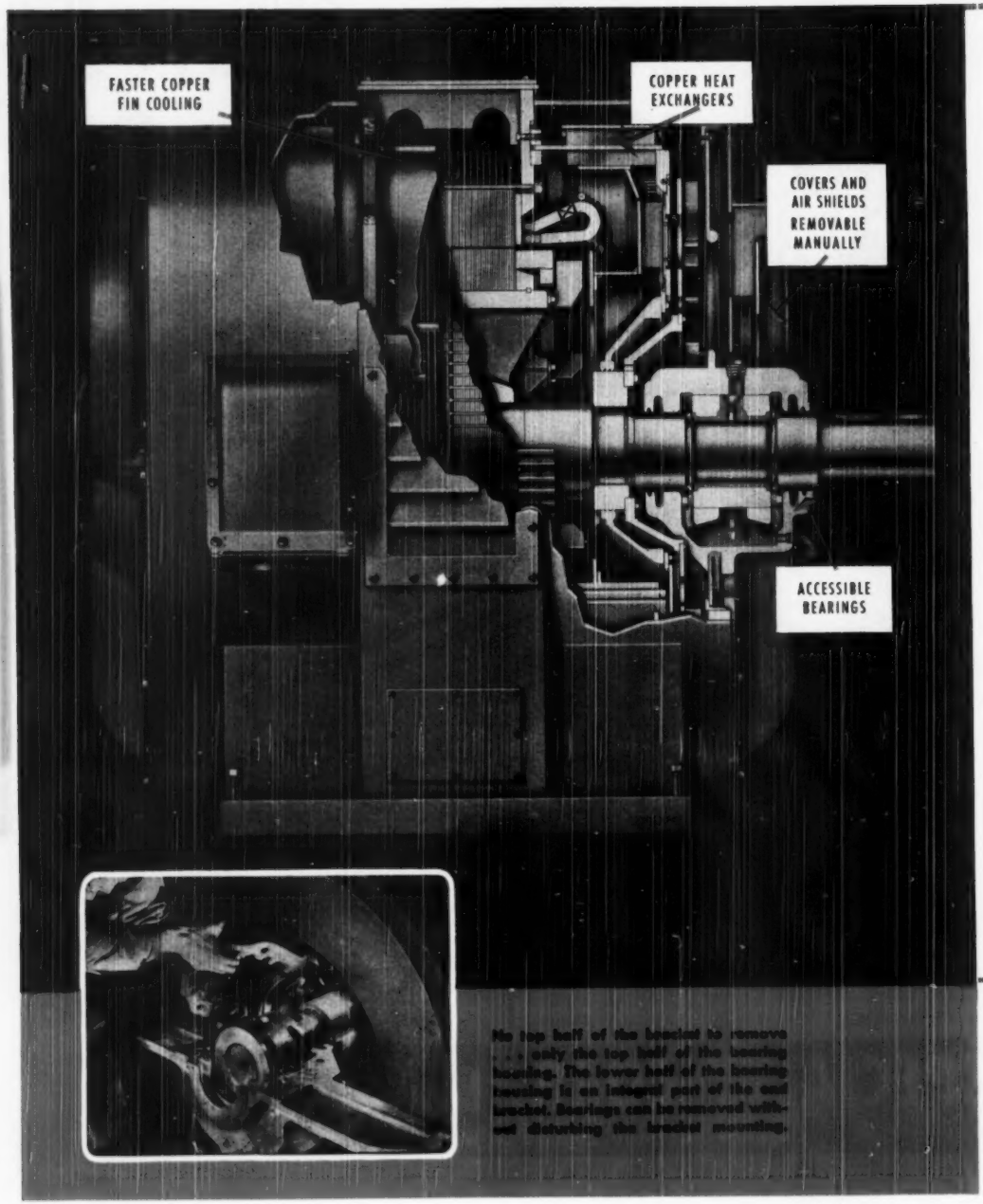


SPECIALTY CORP., Lancaster, Ohio

Diamond Specialty Limited • Windsor, Ontario

4177

YOU CAN BE **SURE**.. IF IT'S
Westinghouse



No top half of the bracket to remove . . . only the top half of the bearing housing. The lower half of the bearing housing is an integral part of the end bracket. Bearings can be removed without disturbing the bracket mounting.

NEW LARGE INDUCTION MOTOR DESIGN

offers important advance in totally-enclosed, fan-cooled motors

Transfer of heat from totally-enclosed, fan-cooled, large motors is now accomplished more efficiently . . . more effectively.

New Westinghouse design and construction employ copper cooling fins to quickly dissipate heat from motor windings and stator core. Heat exchangers, also utilizing copper fins, provide efficient transfer of heat from internal circulating air into the path of the external cooling air. Further, this design permits totally-enclosed construction on frames which *require little more installation space than open motors* of the same rating.

Also included in the new Westinghouse Totally-enclosed, Fan-cooled Motor are basic design improvements common to other enclosure types of Westinghouse large motors. Many are features that contribute appreciably to lower installation and maintenance costs.

For example: sectional covers and air shields, easily removable, by hand; split bearing housings, with bearings readily accessible for inspection or replacement—without removing lower half of housing; sturdy frame of welded steel construction—stronger, smaller in size and lighter in weight.

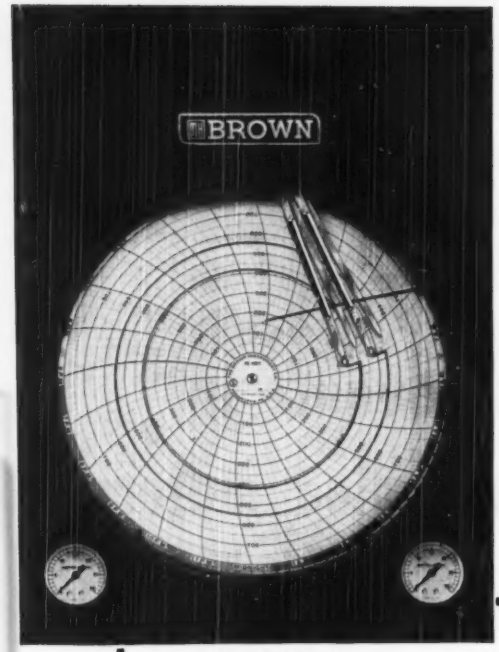
Get the facts now—for immediate use or with an eye toward future requirements.

See your Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-21552

Westinghouse

LARGE INDUCTION MOTORS



Recording Receiver

Indicating Transmitter

Safety...

Brown Pneumatic Remote Transmission uses small lines of copper tubing to replace long runs of expensive and dangerous piping. It keeps high pressure lines at a safe distance . . . away from personnel, away from plant and panel equipment. It lowers the cost of safe, centralized instrumentation . . . and provides ample power, without appreciable lag, over long distances.

A pneumatic transmitter is located at each point of temperature, pressure or flow measurement . . . and sends a signal to a recorder or indicator conveniently mounted on a central panel. Result: an accurate and permanent record of distant conditions, all at one location. The pneumatic transmitter is not affected by fluctuations in air supply or by vibrations. And, the volume of air required is exceptionally small.

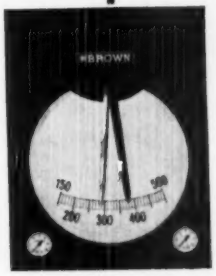
Used by the thousands in the processing industries, Brown Pneumatic Remote Transmission is now gaining wide acceptance with power engineers. For detailed information on low-cost centralized instrumentation . . . with safety . . . call in your local Honeywell engineer. He is as near as your phone!

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Phila. 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

Write, today, for a copy of Bulletin 90-1

. . For Centralized Instrumentation!

WITH BROWN PNEUMATIC REMOTE TRANSMISSION



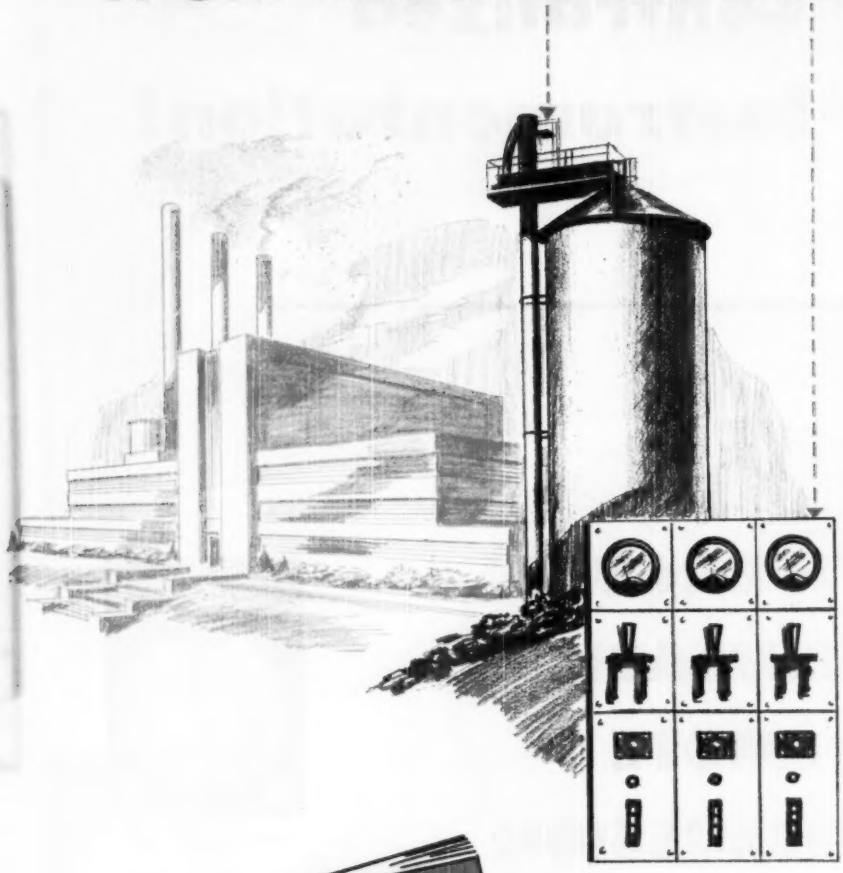
Indicating Transmitter

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

...a KVS

from bunker to bus bar



Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on steam generation and coal pulverization.

RESPONSIBILITY...

your power plant

DESIGNED DELIVERED and ERECTED

Complete Anywhere

This unique service is offered by KVS because KVS is competent to render it and thereby relieve the owner of a tremendous amount of detail. Furthermore, by taking full responsibility for the coordination of all components involved in the designing and building of a complete steam generating plant . . . from "bunker to bus bar" . . . it is possible to guarantee the overall performance of the plant and see to it that operation of individual parts meets specified performance requirements.

Obviously all components in a complete power plant are not built in KVS shops. However, KVS is prepared to furnish such parts and see to it that builders' guarantees are fully met.

Bearing in mind that KVS steam generators are designed and built to produce steam at lowest cost on lowest grades of solid fuels such as tailings, washings, screenings, etc., you can be assured of power at minimum cost wherever such fuels are available.

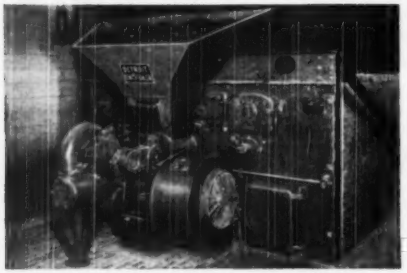
Call on KVS engineers for assistance regardles of where you contemplate erection of your plant. You will find KVS service convenient, competent and complete.

SAVING COAL IS OUR BUSINESS

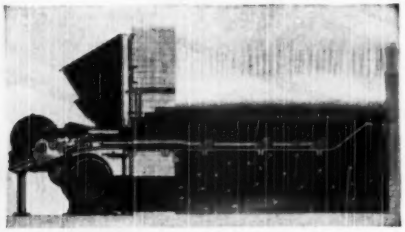
Detroit Stokers save coal by burning it more efficiently and completely. Detroit UniStoker with Detroit Adjustable Feed has a record of decades of remarkable savings.

The UniStoker is a single retort, plunger feed unit type. With individual full housed blower, it constitutes an independent, efficient, self-contained unit. UniStokers respond quickly to changes in steam requirements. Fuel is fed only when needed—none is wasted.

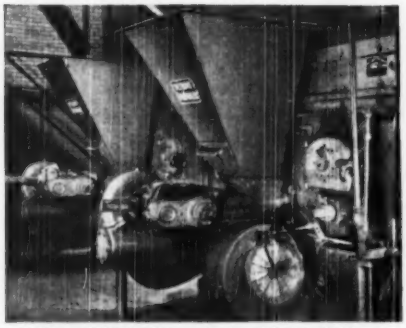
Great Coal Savers—Readily Applied To A Wide Variety Of New Or Existing Boilers, Including The Modern Package Type. Detroit UniStokers Have Made Records Of Large Economy With Every Type of Boiler.



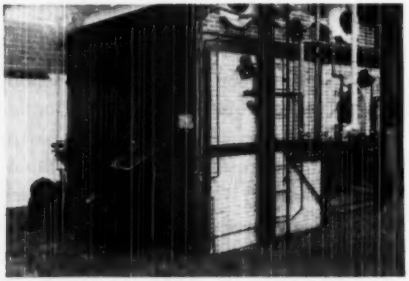
Detroit UniStokers in Miller Vocational High School, Minneapolis, Minn.



Detroit UniStoker has a deep sectional retort of large capacity. Arrows indicate flow of air for combustion.

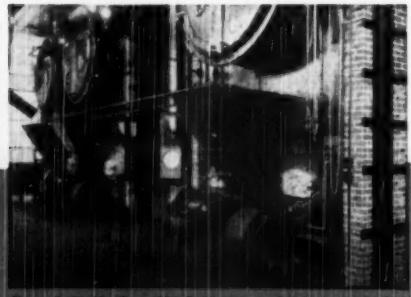


Detroit UniStokers—Industrial Arts Bldg. Barberton, Ohio, High School.



Detroit UniStokers Firing Three Drum Bent Tube Boilers—Ashtabula Hospital, Ashtabula, O.

Detroit UniStokers With Package Type Boiler, Chambersburg Engineering Co., Chambersburg, Pa.



Detroit UniStokers With Horizontal Return Tubular Boilers—International Silver Co., Meriden, Conn.

ECONOMIES SUCH AS THESE ARE NOT UNUSUAL

"100% More Steam For Only 18% More Fuel" —Record of Detroit UniStoker in a Hospital.

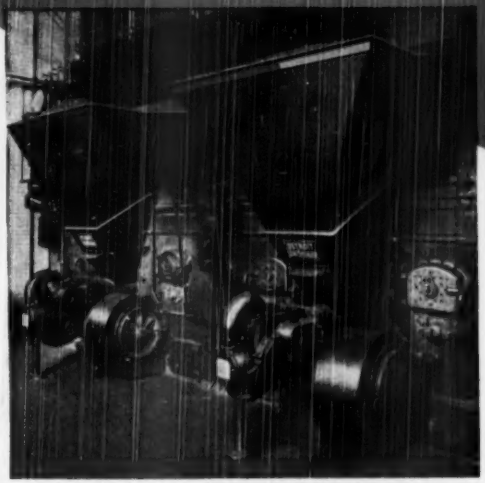
"$3,067 Saved in Eight Months Time By Two UniStokers"—A city water works reports.

"Our Detroit UniStoker Is Saving Annually More Than 50% of Its Total Cost"—Says a paint manufacturer, who adds that smoke is no longer a problem.

"Four UniStokers Reduce Operating Costs $5,000 Per Year"—A rubber company which is a heavy user of process steam.

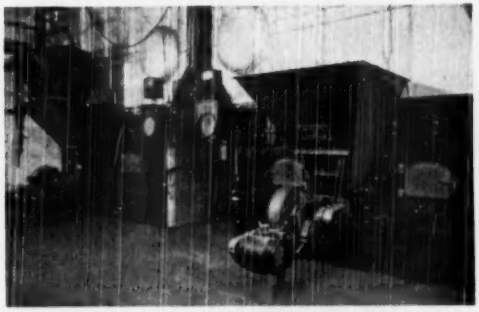
"Saving in Coal Consumption 35%"—Is the report from a brewery using UniStokers.

"$1,367 Saved First Year"—Record of UniStoker operation in a Sanatorium.



Detroit UniStokers in a State Educational Institution in Lock Haven, Pa.

The Detroit Adjustable Feed of the UniStoker is simple and reliable for automatically changing coal feed in proportion to the air supply and the steam requirement. Manual adjustment provided.



Wolverine Brass Works, Grand Rapids, Mich. Stokers driven by individual motors, fans are at rear of boilers.

DETROIT STOKERS SINCE 1898

You too can save money with

DETROIT STOKERS

Write for full information and catalog—no obligation

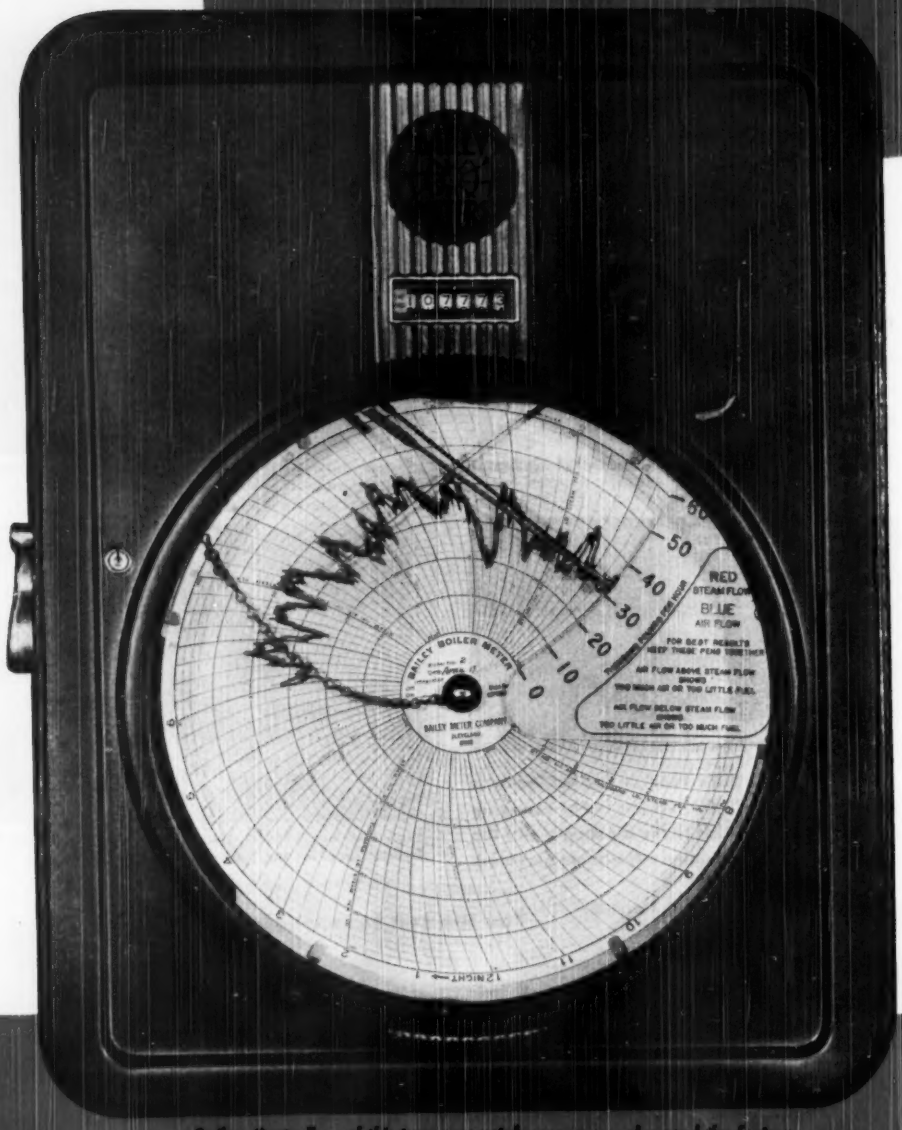
DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

Works at Monroe, Michigan District Offices in Principal Cities

OTHER TYPES AND SIZES OF DETROIT STOKERS FOR EVERY INDUSTRIAL OR POWER NEED

Whatever Fuel


BAILEY BOILER METER
BAILEY METER COMPANY
RED
STEAM FLOW
BLUE
AIR FLOW
FOR BEST RESULTS KEEP THESE PENS TOGETHER
AIR FLOW ABOVE STEAM FLOW SHOWS TOO MUCH AIR OR TOO LITTLE FUEL
AIR FLOW BELOW STEAM FLOW SHOWS TOO LITTLE AIR OR TOO MUCH FUEL
12 NIGHT

Bailey Controllers of this type accurately measure and record the factors upon which controls are based.

You Burn—You'll Save Money with BAILEY CONTROLS

You'll get high Economy, Safety and Availability because Bailey Controls, working from the accurate measurements of Bailey Meters, do the right thing at the right time.

Bailey Combustion Control

1. Secures instant response to changes in load by regulating both fuel and air at the same time.
2. Maintains optimum fuel-air ratio as measured by Bailey Meters.
3. Gives you the same complete control, when you change fuel, or even when you burn waste.

Bailey Three-element Feed Water Control

1. Reacts quickly and yet retains high stability by accurately measuring Steam Output and Feed Water Input and by controlling the rate of feed water input so that it equals steam output.
2. Surge resulting from severe load changes is held to a minimum by the action of flow ratio and level components which may be adjusted to conform with boiler characteristics and operating conditions.
3. Needs no excess pressure control because its operation is based in part on an accurate measurement of feed water input.
4. Power used by feed pumps may be reduced by applying Three-element Feed Water Control directly to pump speed.

Bailey Steam Temperature Control

Maintains uniform temperature by controlling primarily from boiler load and by readjusting from temperature.

Bailey Feed Heater Control

1. Gives smooth efficient flow through heaters because its multi-element action incorporates accurate measurements of both flow and level.
2. Permits the use of smaller storage capacity heaters and tanks thereby reducing the cost of initial equipment.

Bailey Pump By-Pass Control

Protects pumps by opening a by-pass valve when flow through the pump drops below the safe minimum value.

BAILEY METER COMPANY

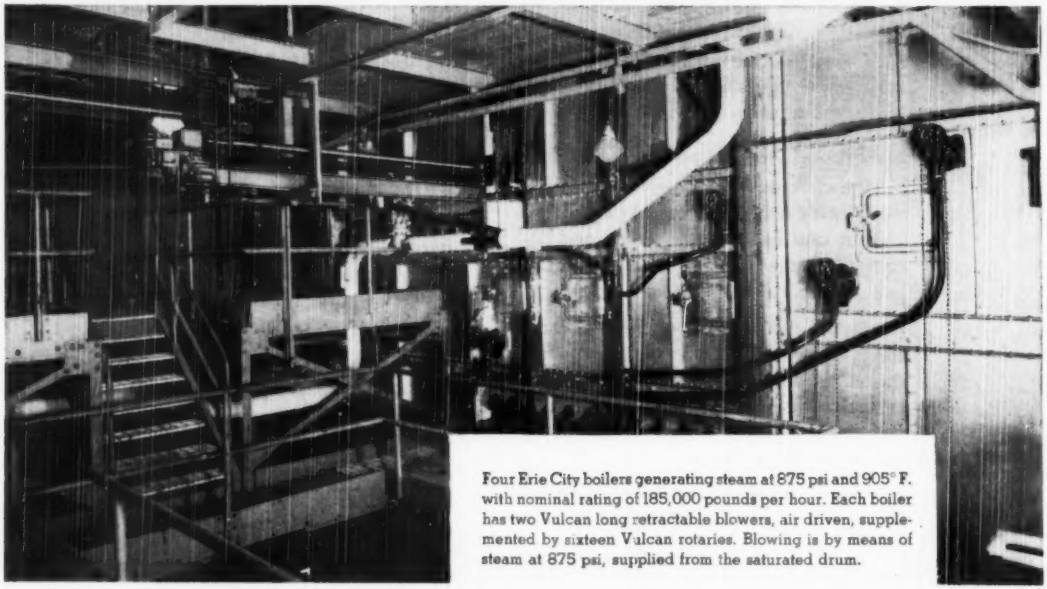
1036 IVANHOE ROAD • • • CLEVELAND 10, OHIO

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

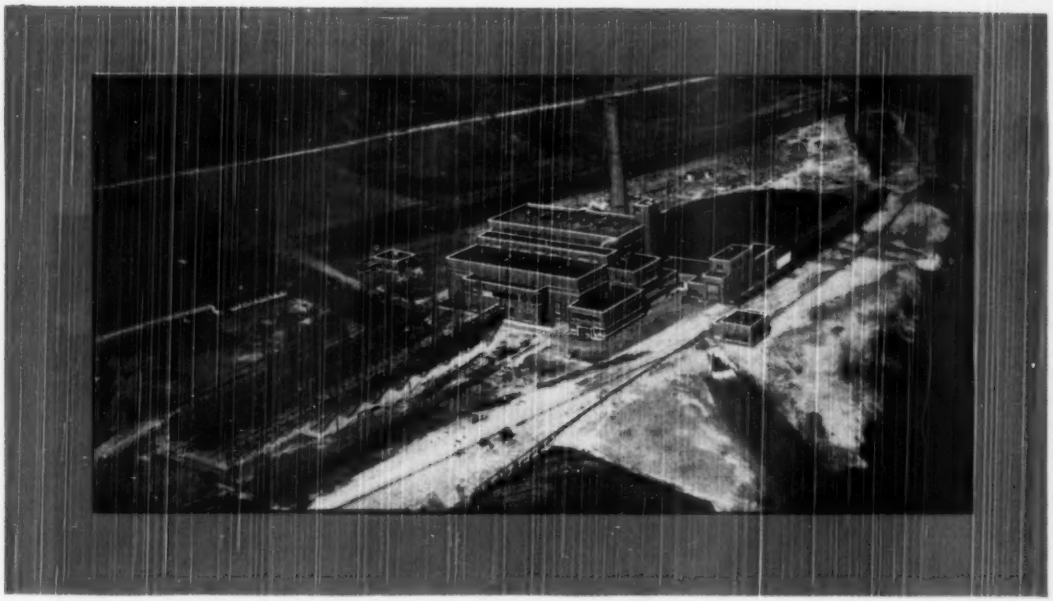
L-99

VULCAN AT WARREN STATION of PENNSYLVANIA



Four Erie City boilers generating steam at 875 psi and 905° F. with nominal rating of 185,000 pounds per hour. Each boiler has two Vulcan long retractable blowers, air driven, supplemented by sixteen Vulcan rotaries. Blowing is by means of steam at 875 psi, supplied from the saturated drum.

VULCAN Automatic



ELECTRIC COMPANY

ADD Warren to the growing list of modern utility stations using Vulcan for better boiler cleaning at lower cost. Here the primary soot blowing job is done by long retractables, controlled from the boiler operating panel—with supplementary cleaning, when needed for other areas, provided by rotary units. The result? Clean boilers, plus money saved.

Pennsylvania Electric has also selected Vulcan for the two new 1300-psi, 955° F. units rated at 400,000 pounds per hour at the Front Street Station in Erie, Pennsylvania.

• • •

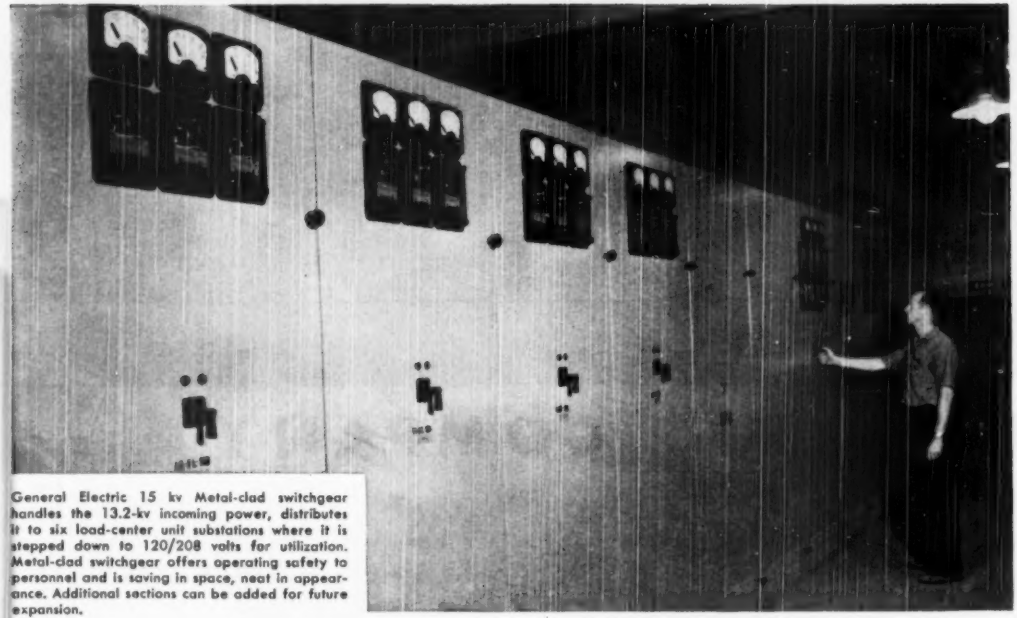
Whatever your problem of soot blowing or de-slagging, depend on Vulcan for an effective solution that will cut your operating cost.

VULCAN SOOT BLOWER DIVISION

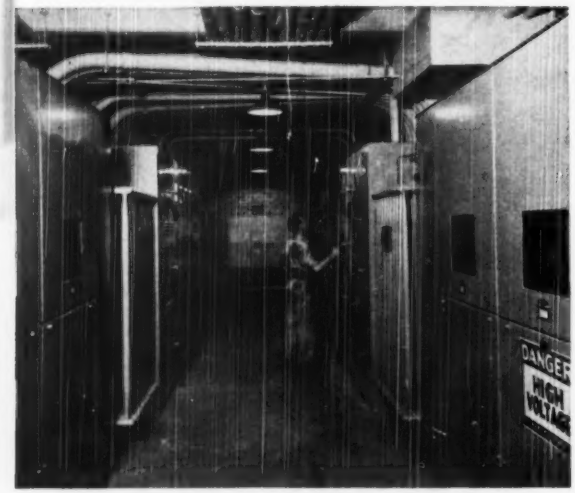
Continental Foundry & Machine Company

DUBOIS, PENNSYLVANIA

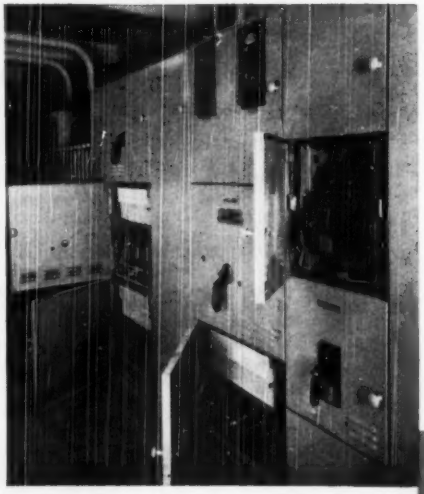
METAL CLAD SWITCHGEAR



General Electric 15 kv Metal-clad switchgear handles the 13.2-kv incoming power, distributes it to six load-center unit substations where it is stepped down to 120/208 volts for utilization. Metal-clad switchgear offers operating safety to personnel and is saving in space, neat in appearance. Additional sections can be added for future expansion.

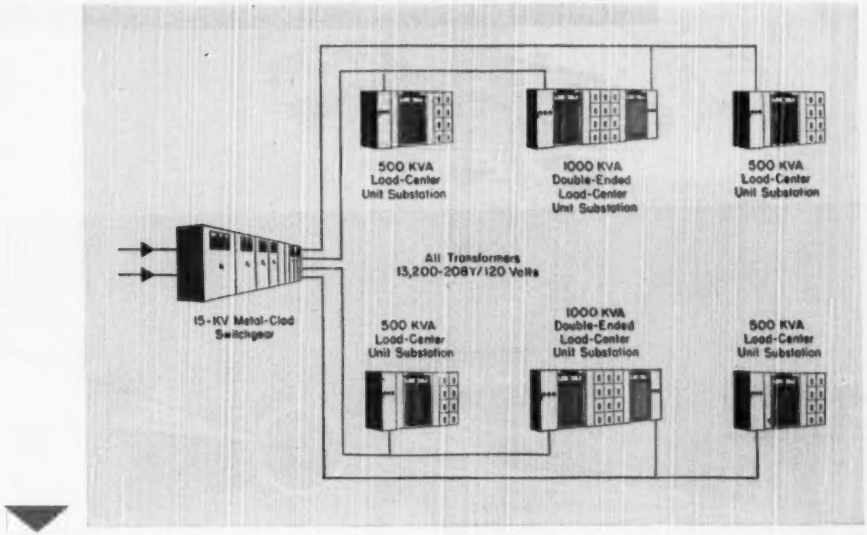


Load-center unit substations receive 13.2 kv power and step it down to 120/208 volts for utilization. Air switches on primary are easy to operate, blades are easy to see. Note entire load-center is metal-enclosed thus offering operating safety to personnel.



Low-voltage end of load-center unit substation showing air circuit breakers that have plenty of "IC" (Interrupting Capacity) to handle all short circuits. Breakers are of the drawout type, easily removable for inspection or maintenance.

HELPS PROTECT SERVICE AT TELEPHONE COMPANY INSTALLATION



In this installation General Electric Metal-clad switchgear receives the incoming 13.2 kv power and distributes it to six G-E load-center unit substations. Three load-centers, two single-ended units rated 500 kva and one double-ended rated 1000 kva, are located in the basement. Three other units of identical rating are on an upper floor. From these load-centers utilization circuits feed 208/120-volt power both upwards and down, and provide efficient, low-cost power at constant voltage wherever desired.

This installation is a complete General Electric project—one source of responsibility plus the very best in coordinated planning, engineering, manufacturing, and service facilities to give maximum savings and efficiency to the customer.

Be sure to see the "More Power to America" full-color sound slidefilm "Modern Industrial Power Distribution." Ask your G-E sales representative to arrange a showing for your organization.

MODERN INDUSTRIAL power distribution systems using G-E switchgear are applicable to any industrial plant or commercial building where you want proper voltage for top performance of equipment, an extremely flexible setup to take care of expanding or changing loads, adequate short circuit protection, safety to personnel, and low installation and maintenance costs.

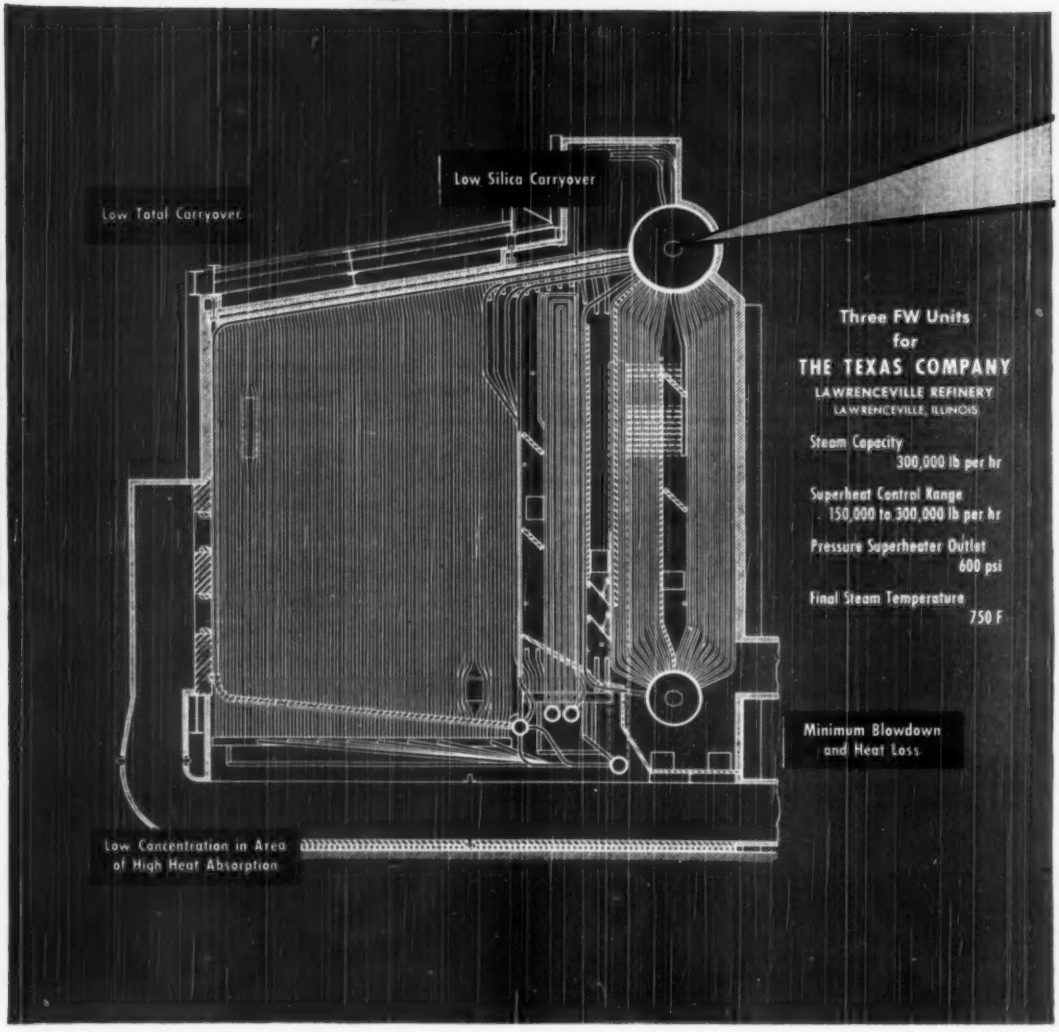
INVESTIGATE TODAY the many advantages of using General Electric switchgear in *your* plant for efficient, flexible power distribution. Contact your G-E sales representative for further information—or write for the helpful bulletins listed below. *Apparatus Department, General Electric Company, Schenectady 5, New York.*

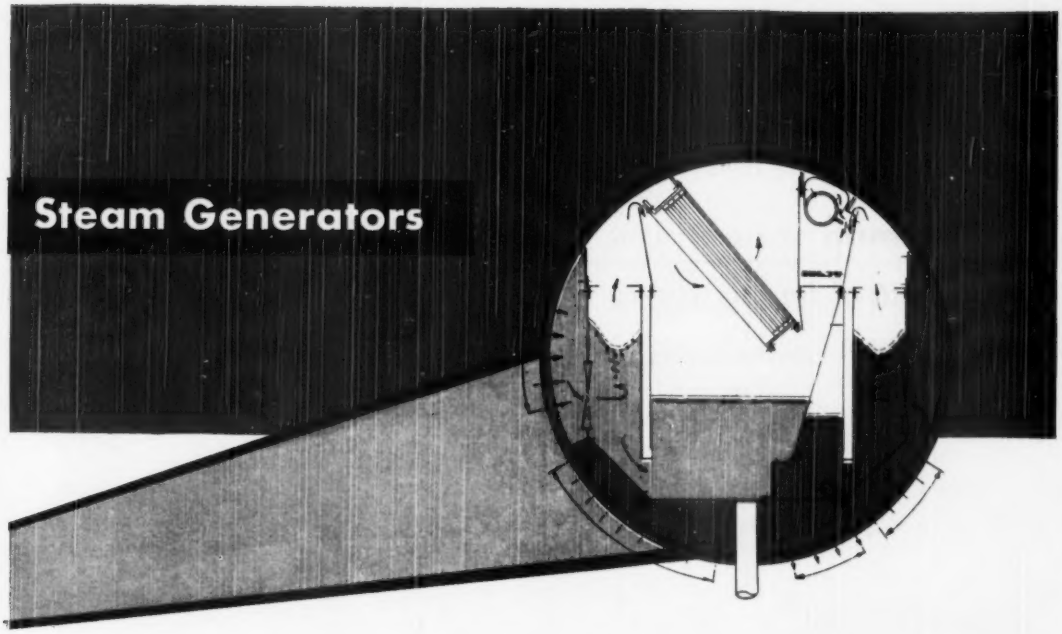
GEA-3083 Metal-clad Switchgear
GEA-4966 Low-voltage Metal-enclosed Switchgear
GEA-3592 Load-center Unit Substations
GEA-3758 Load-center Power Distribution

GENERAL ELECTRIC

high steam purity where it counts

Foster Wheeler Dual Circulation





Advantages for Both Central Station and Industrial Use

Under modern operating conditions of high pressure and temperature, the problem of steam purity is of increasing concern to the designers and operators of industrial and central station steam generators. Foster Wheeler engineers have successfully met this challenge by developing the Dual Circulation Steam Generator which already provides materially *higher availability, improved efficiency,* and *lower maintenance of high pressure steam turbines* at one large midwest refinery. Particularly in installations which have high makeup requirements, the Dual Circulation Steam Generator is capable of providing steam of higher purity with less blowdown than is possible in a conventional unit. In units operating on condensate, total solids and especially silica carryover are almost negligible with this design.

Design Features of Dual Circulation Steam Generator

The Foster Wheeler Dual Circulation Steam Generator consists of two separate heat absorbing sections each with its own independent circulating system. The feedwater goes to the primary, high duty, radiant heat absorbing section, which is continuously blown down into the low duty secondary convection section. Most of the steam is generated in the primary section where silica and boiler water concentrations are low. Thus, a marked reduction in the amount of silica carryover in the steam to the prime mover is achieved and tube damage is held at a minimum.

The Texas Company Orders Three Units for Lawrenceville Refinery

Because of adverse water conditions at the Lawrenceville Refinery, The Texas Company ordered three units, designed for high make-up with high concentration in its makeup. The Lawrenceville project is part of the present construction program in which all crude units are being engineered and constructed by Foster Wheeler.

For further information, write:

FOSTER WHEELER CORPORATION, 165 BROADWAY, NEW YORK 6, NEW YORK

FOSTER WHEELER

This man *can help you*

control temperatures

accurately—economically

He's the man who can show you the proper insulation to give maximum heat and power for each fuel dollar expended

An Eagle-Picher Industrial Insulation distributor or representative can help you reduce operating expenses because he has available a wide line of insulation products—for high and low temperatures—scientifically designed for maximum thermal efficiency, and practical application. Why not let him give you more information about some of the products listed here?

These Eagle-Picher products can save you money . . . power . . . time

Insulating Felts • Supertemp Blocks • Blankets • Loose Wool Pipe Covering • Stalastic • Insulseal • Insulstic • Swetchek Finishing Cements • Insulating Cements • Fireproofing Cement Diatomaceous Earth Blocks

EAGLE EP PICHER *Since 1843*

THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

Here's one insulation that will save you money

EAGLE-PICHER DIATOMACEOUS EARTH BLOCKS #85 and #95

A highly efficient, rigid-type insulating material composed almost entirely of pure, lightweight, Eagle-Picher Diatomaceous Earth. High physical strength enables these blocks to stand up well under the handling and usage normally encountered in installation. Adaptable to virtually all types of heated equipment. Can be cut with a knife or saw to fit irregular shapes. DE-85 Blocks for temperatures to 1300° F. DE-95 Blocks for temperatures to 2000° F.

These efficient, versatile insulations "team up" to give perfect insulation for every major application

You can't beat the teamwork of Eagle-Picher Super "66" Insulating Cement, Eagle-Picher Insulseal and Eagle-Picher Insulating Blocks (Supertemp Blocks, Diatomaceous Earth Blocks No. 85 for temperatures up to 1300° F., and Diatomaceous Earth Blocks No. 95 for temperatures up to 2000° F.). They work effectively to give your equipment highest possible thermal efficiency . . . cut operating costs by saving the maximum amount of fuel . . . and help to provide perfect, precise control over temperatures.

EAGLE-PICHER SUPER "66" INSULATING CEMENT

Super "66" is all-purpose, rust-inhibitive, extremely adhesive insulating cement. "Springy ball" pellets don't collapse after application . . . give great coverage, retain their thermal efficiency. 100 lbs. covers 65 sq. ft.—1 inch thick. Easily applied with trowel, over flat and irregular surfaces. Efficient for temperatures up to 1800° F. Reclaimable when used on equipment whose temperatures do not exceed 1200° F.

EAGLE-PICHER SUPERTEMP BLOCKS

Eagle-Picher Supertemp Blocks are lightweight (approximately 16 lbs. per cu. ft.). Can be cut easily with knife or saw to fit off-shaped areas . . . they fit snugly over minor irregularities. They're strong and have high refractory value. Withstand temperatures up to 1700° F. Conductivity at 512° F. approximately 0.43 . . . all standard sizes, from 3"x18" to 12"x36" in thicknesses from 1" to 4".

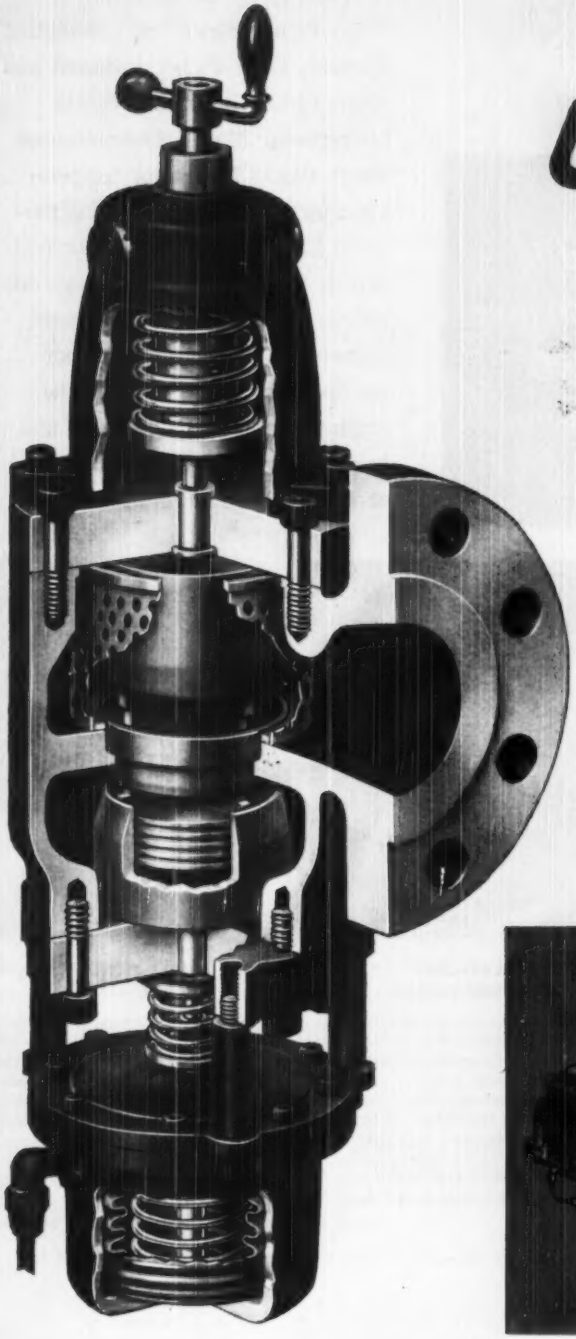
EAGLE-PICHER INSULSEAL

A tough, weatherproof, protective coating for insulation. For temperatures up to 450°F. Applied as a plastic, its smooth troweling qualities assure uniform coverage, proper thickness. It protects insulation from air infiltration, fumes, rain, snow, vibration, punctures, and withstands severe service, indoors or out. Dries to a smooth, rich black, has a neat appearance on hot or cold surfaces . . . may be washed or painted.

Be sure to visit Eagle-Picher's booths 61 and 62 at the 49th National Power Show, St. Louis, Missouri, August 15, 16, 17, 18, 19.

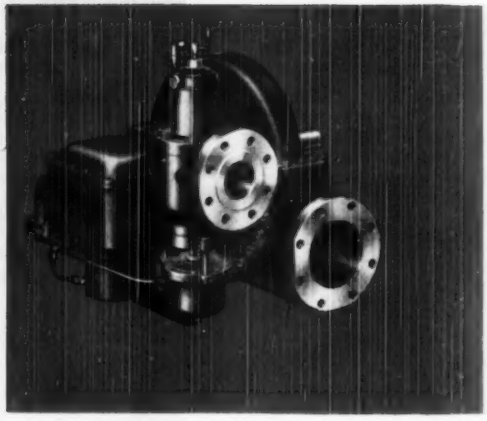
THE EAGLE-PICHER COMPANY General Offices: Cincinnati (1), Ohio

Insulating Felts • Supertemp Blocks • Blankets • Loose Wool • Pipe Covering
Stalastic • Insulseal • Insulstic • Sweetchek • Finishing Cements
Insulating Cements • Fireproofing Cement • Diatomaceous Earth Blocks



GET THE

TYPE DP



BEST IN VALVING

WITH STANDARD TURBINE DRIVES

On General Electric's standard Type DP mechanical-drive turbine, the trip-throttle valve and the governing valve are combined into one casing. This exclusive G-E feature provides a compact and neat design which simplifies piping by usually eliminating the need for a separate valve in the steam line. You get easier operation, too, because pressures across the valves are equalized. The throttle valve mechanism is ball-bearing mounted, and only hard packings are used.

POSITIVE OVERSPEED PROTECTION

A bolt-type emergency governor, mounted in the turbine shaft, actuates a trip mechanism when speed rises 15% above normal. This action trips the throttle valve closed, positively shuts off steam flow to the turbine. A convenient hand lever is also provided for tripping the valve.

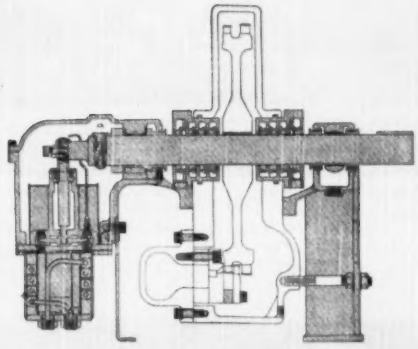
BETTER GOVERNING AND REGULATION

Working with the DP's powerful hydraulic governor, the governing valve gives you greater performance accuracy. The balanced reaction design reduces valve unbalance to a minimum. Relief holes equalize pressure between the valve and the guide piston of the seat. Hard packing decreases the force required to move the valve, results in smoother operation.

LONG LIFE AND DEPENDABILITY

The stainless steel stem and nitrided stainless steel valve and seat are designed to last for years. Maintenance is cut through the use of corrosion-resistant labyrinth stem sealing bushings. No soft packings are used. An easily removable monel steam strainer in the throttle valve chest halts foreign material before it can reach valve or steam parts.

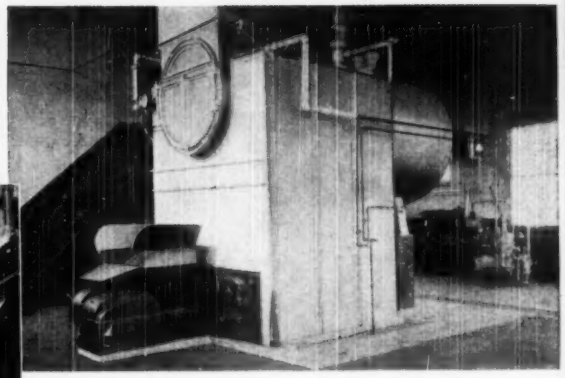
Look into *all* the features of the standard DP turbine. You'll find many extras, such as the valving, which can give you the performance and savings you want from a mechanical-drive turbine. Contact your nearest G-E sales office, or write for bulletin GEA-4955. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*



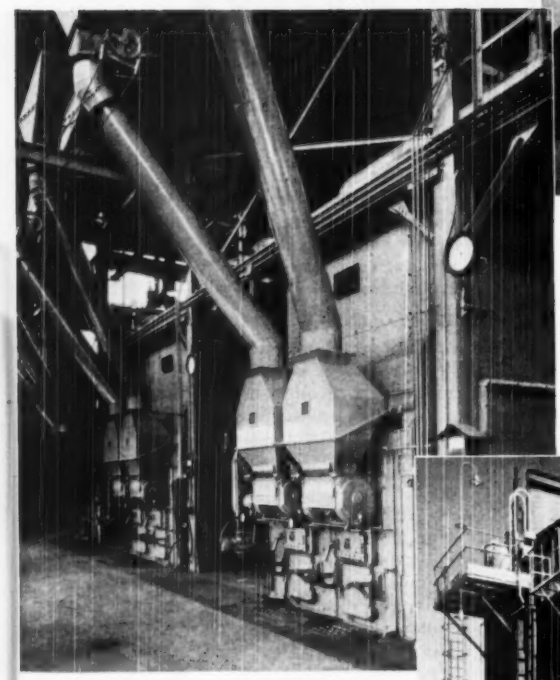
HOW STANDARDIZATION WORKS FOR YOU

In the diagram at the left, all shaded parts are interchangeable on all sizes of DP turbines. Thus, it is easy to stock spares, and maintenance costs are reduced. All models have standard shaft height and coupling fits for easy installation or re-location in your plant. Standardization cuts manufacturing expense and the savings are passed on to you in the form of extra features, usually found only on "special" turbines.

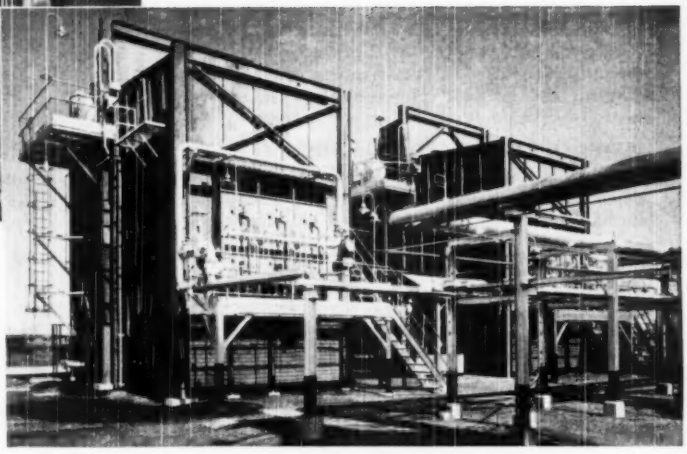
GENERAL ELECTRIC



Planning



Installation for medium and smaller plants . . . pressure to 475 psi . . . capacity to 60,000 lbs. of steam per hr . . . suitable for any type of fuel.



Installation for larger plants . . . pressure to 1000 psi . . . temperature to 900 F . . . capacity to 350,000 lbs. per hr . . . any fuel or type of firing . . . indoor or outdoor type construction.

COMBUSTION ENGINEERING

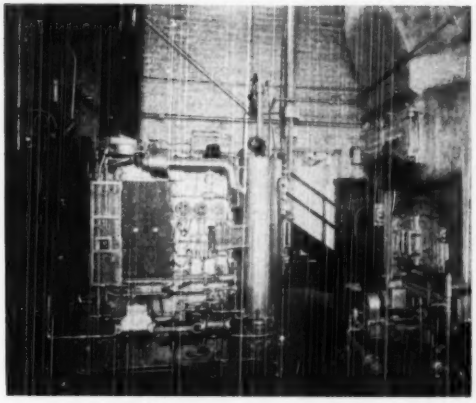
A MERGER OF COMBUSTION ENGINEERING COMPANY, INC. AND THE SUPERHEATER COMPANY

Installation for small plants . . . pressure up to 150 psi . . . capacity to 12,000 lbs. of steam per hr . . . adaptable to any fuel.

? to buy BOILERS

. . . this year

. . . next year



Installation for special conditions including very limited space . . . quick steaming (full capacity in 3 min.) . . . fully automatic operation . . . capacity to 6000 lbs. of steam per hr . . . pressure to 300 psi. Ideal for intermittent load.

Sometime this year, or perhaps next, your company may decide to buy new boilers . . . to replace obsolete units . . . to meet increasing steam demands . . . or for a new plant. Whatever the time or circumstances, here's something it will pay you to remember. With fuel and operating costs firmly established at new high levels, today more than ever before, the first cost of a new boiler is decidedly secondary to the annual operating cost. In fact, the annual cost of fuel alone for the average boiler installation nowadays usually equals or exceeds the purchase price. And the normal life of a boiler should be 20 to 30 years, or longer.

Obviously, then, the operating economies accruing from better design, construction or application, will quickly offset the difference between the cheapest boiler you can buy and the best the market affords. Here is one case where the old adage "the best is the cheapest" really applies.

In addition to having installed thousands of industrial boilers . . . in every size category from less than 100 horsepower up . . . Combustion has designed and built many of the country's largest utility power station boilers. And it is in this field — the manufacturing of power on a large scale — that boiler design and construction are evaluated most critically and exhaustively.

The fact that C-E Boilers have been selected to meet the exacting performance standards of so many of the nation's largest utility power stations is evidence of the quality of design and construction you can expect to find in any boiler, large or small, that bears the Combustion nameplate.

Our recommendations as to the most suitable type of boiler and firing equipment for the *specific requirements* of your next installation are available to you and your consultants without obligation.

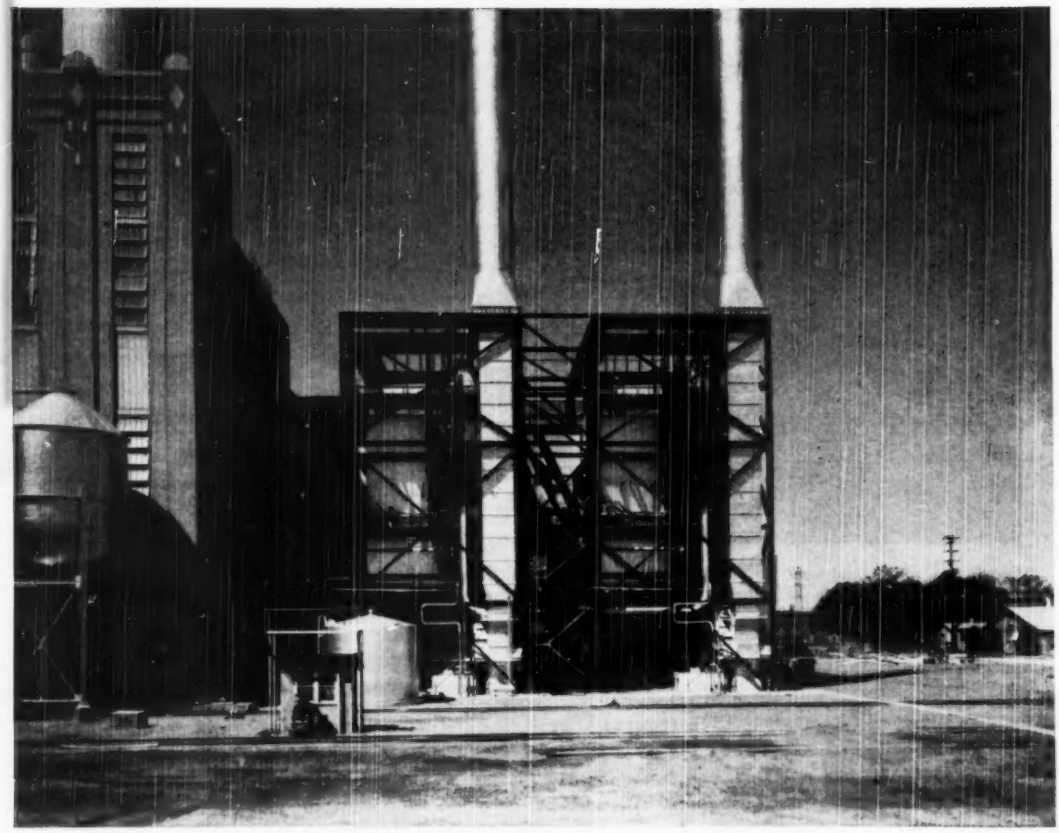
B-383A

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

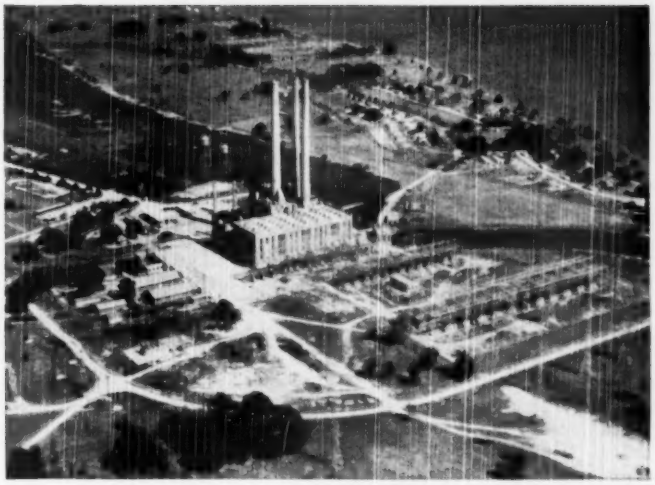
C-E

Two Outdoor Boilers Under Automatic



Outdoor Installation of Two Large Boilers at the Trinidad Steam Electric Station.

Aerial View of Trinidad Steam Electric Station. (Note the Two Outdoor Boilers Installed Behind the Main Building).



Control

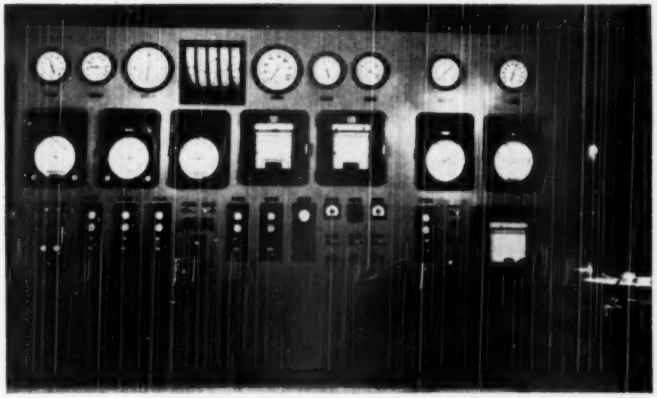
at TRINIDAD STEAM ELECTRIC STATION • Texas Power & Light Company

● A most important part of the Texas Power and Light Company expansion program at their Trinidad Steam Electric Station, is this outdoor installation of two new gas fired, 350,000 lb. per hr. boilers. These boilers, operating at 920 psig., provide 70,000 KW additional capacity to meet the increasing power demand on the Trinidad Station. To achieve maximum efficiency and performance, the boilers were put under completely automatic control.

The AUTOMATIC COMBUSTION CONTROL system and the PRESSURE REDUCING AND DESUPERHEATING STATION were supplied by REPUBLIC FLOW METERS CO.

A Potent Tool for Cutting Costs

A properly engineered automatic control system is an effective way to cut power costs. Best of all, what automatic control is doing for the large plants such as the Trinidad Steam Electric Station it is also doing for their smaller brothers. But the full benefits can only be realized if the plant designer selects with great care the best control equipment for his job. The control must be carefully matched to the boiler and auxiliary equipment characteristics; it must maintain maximum combustion efficiency under all load conditions.



One Section of the Boiler Control Panels.

REPUBLIC CONTROLS are available for all types of load fluctuations, fuel firing, single or multiple fuels, and all types of boilers and auxiliary equipment. Backed by thirty-six years of specialized experience in combustion control, REPUBLIC'S power engineers have developed control systems to answer every type of steam generating problem.

Ruggedly built to outlast the boilers that they serve, REPUBLIC AUTOMATIC CONTROL gives you the best, most economical system engineered to suit your needs.

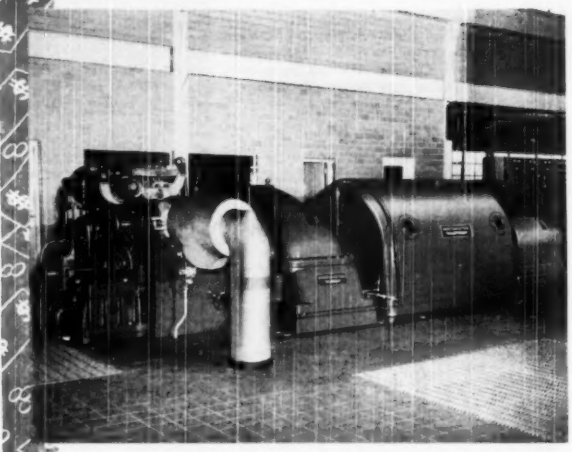
For more information on REPUBLIC AUTOMATIC CONTROL write for Data Book No. S-21 or contact our field engineer nearest you.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

FACTS ABOUT THE

Most Profitable Turbine Generator Investment

YOU CAN MAKE...



One of two Worthington 4000 kw turbine generator sets installed in a mid-western municipal power plant, operating on 600 #G and 750 F.T.T. Steam exhausting to 28" Hg vacuum.

Worthington's Experience and Undivided Responsibility Assure Low Cost, Dependable Power

Builders of steam turbines for over 30 years, Worthington's Steam Turbine Division is backed by the experience and resources of the entire Worthington organization — recognized leaders in the power plant field for more than a century. In view of today's increased turbine pressures and temperatures — and the resulting needs for new and special materials — this vast, combined source of technical knowledge has proved of tremendous practical value in developing turbine design, construction and performance.

Generators Are Worthington's, Too

The generators used with Worthington Turbines are built by a Worthington subsidiary that has specialized in this field for over 45 years. This means that Worthington, as manufacturers of *complete* turbine generator units, assumes *undivided responsibility* for the coordinated design, assembly and performance of these units.

Before shipment, Worthington Turbines and Generators are assembled together *as units* for testing and adjustment — eliminating the necessity for doing this after installation. Also, for installation and service, Worthington turbine specialists and regular Worthington service men are always available from our District Offices throughout the country.

Check These Over!

Adding up, Worthington's matchless power plant experience . . . huge manufacturing facilities . . . long specialization in both turbine and generator manufacture . . . undivided unit responsibility . . . and skilled technical service . . . are the best assurance you can get anywhere of efficient, economical steam turbine power.

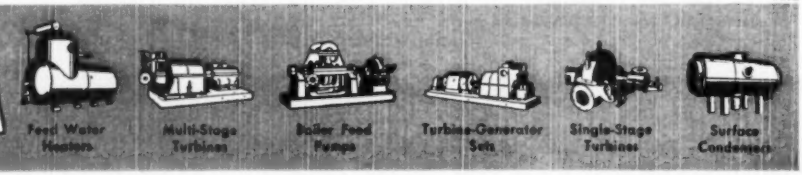
Worthington makes turbines in a wide range of sizes and types, each one designed to make steam do more work. For details proving *there's more worth in Worthington*, contact your nearest Worthington representative. Or write to *Worthington Pump and Machinery Corp., Steam Turbine Division, Wellsville, N. Y.*

WORTHINGTON

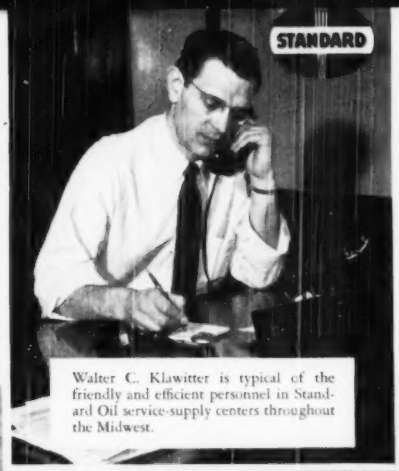
STEAM TURBINES

T0.2

A GREAT TEAM IN STEAM



Easy local call . . .



Walter C. Klawitter is typical of the friendly and efficient personnel in Standard Oil service-supply centers throughout the Midwest.

3 IMPORTANT ADVANTAGES

Standard Oil's Lubrication Service is especially geared to serve your midwest operations.

1 Service-supply points are near your plant. You are assured of fast deliveries, prompt lubrication engineering service.

2 Lubrication specialists have been specifically trained in Standard Oil Lubrication Engineering Schools to help you obtain the maximum benefits from lubricants and fuels.

3 Research and technical facilities are geared to help solve your specific lubrication problems.

Fast local delivery

• Anywhere in the Midwest: a simple, local phone call will bring you any petroleum product you need—double-quick! Here's why: a service-distribution set-up—unique in the oil industry—has a Standard Oil office and warehouse located practically in your own backyard! Adequate stocks of the lubricants and fuels required for the efficient operation of your plant are warehoused at that service-supply center. You can always get the product you need—*when* you need it—delivered right to your door.

Here, too, are the local headquarters for a Standard Oil lubrication specialist. He is close at hand, will give you on-the-spot engineering service. He has plenty of practical experience. He has been specially trained for his job in a Standard Oil Lubrication Engineering School. He is backed by Standard Oil's extensive research and technical facilities.

Let this lubrication specialist and Standard Oil's efficient supply service help you make real savings. Phone your local Standard Oil (Indiana) service-supply center* today.

Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

***Service-supply centers are located throughout: Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Montana, Missouri, Nebraska, North Dakota, South Dakota, Oklahoma, Wisconsin, Wyoming.**

STANDARD OIL COMPANY (INDIANA) STANDARD

Here's help for bearings in "HOT WATER"

New booklet tells how STANOLITH Greases solve wet-hot problems

HOW TO LUBRICATE bearings which operate under extremely wet conditions, and at the same time, are subjected to high temperatures? If that is one of your problems, the booklet illustrated above holds the solution.

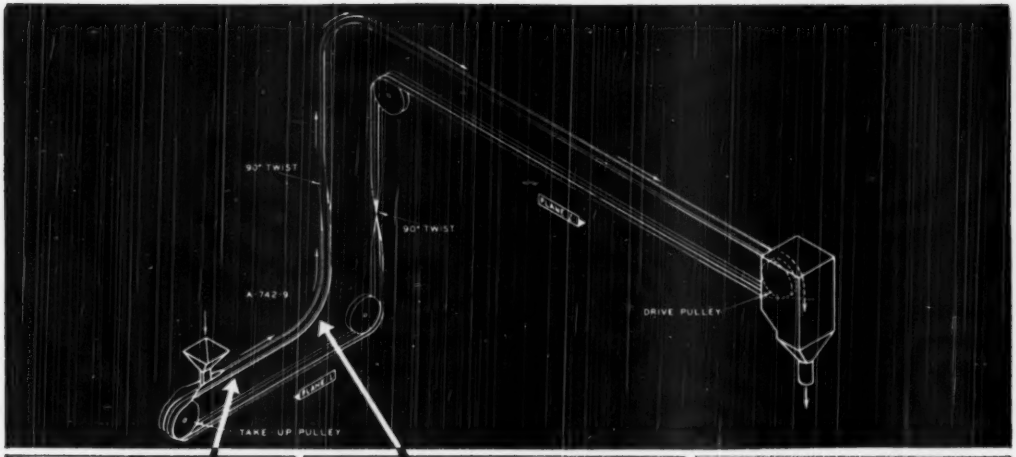
It tells you about the outstanding qualities of Standard Oil's new STANOLITH Greases. It explains why these lithium soap products—unlike soda soap or lime soap greases—will withstand *both* heat and water. The booklet contains evidence of this ability. It gives actual case histories of some of the many different jobs on which STANOLITH Greases have eliminated troubles caused by high temperatures, presence of steam or water, and high speeds. It also describes successful low-temperature service.

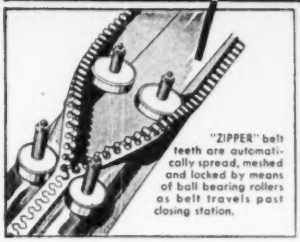
Study this wide range of applications. Discover how the two grades of STANOLITH Grease not only can solve difficult lubrication problems but can save you the cost and trouble of stocking and using a variety of special greases. Send for this information. Write for your copy of the STANOLITH booklet today. Simply address your letter to:

Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

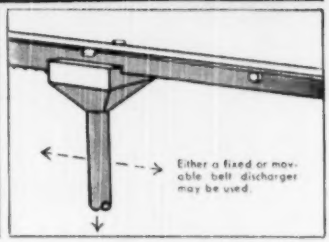
STANDARD

STANDARD OIL COMPANY (INDIANA)




"ZIPPER" belt teeth are automatically spread, meshed and locked by means of ball bearing rollers as belt travels past closing station.

Section through endless "ZIPPER" belt, shows how load is completely enclosed and protected.


Either a fixed or movable belt discharger may be used.

"ZIPPER"—Has One "RUBBER MUSCLE"

—As Flexible as a Hose!

"ZIPPER"—the new conveyor-elevator developed by S-A engineers, does the work of several conventional conveyor-elevators. But, with its one continuous "rubber muscle", "Zipper" does the same work, in less space, and with the elimination of extra drives, transfer spouts, casing, breakage and dust.

"Zipper" conveys horizontally, vertically or on inclines—in any direction and in any plane. Sidewalls are closed around the load to eliminate spillage and escape of dust as well as contamination from outside. "Zipper" moves around obstructions—carries its load gently without breakage or segregation.

Belt opens for complete discharge and cleaning when necessary. Speeds may be regulated up to 200 FPM. Pulverized, granular, lumps or flaky materials are particularly suited to "Zipper" application. This system is not only "flexible" in operation but also in its adaptability to many applications—probably including some problem of yours.

Ask for recommendations of S-A engineers on how new "Zipper" can serve you. There's no obligation so write today.

FOR EXAMPLE AT
MANSFIELD SANITARY
POTTERY, INC.
PERRYSVILLE, OHIO

1st dry ball clay and other fine materials are drawn from storage silos and delivered to cylindrical underground dump hopper equipped with an S-A two-stage circular bin discharger. Materials are fed to "ZIPPER" belt conveyor which moves 32 feet upward, and makes a 90-degree turn to processing building. Over 95 feet of horizontal run over 5 mixing tubs, movable belt discharger can be spotted over any mixer. This S-A "ZIPPER" system fitted into existing layout without structural alterations.

STEPHEN S-A ADAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif. • Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

GUN-PAKT EXPANSION JOINTS

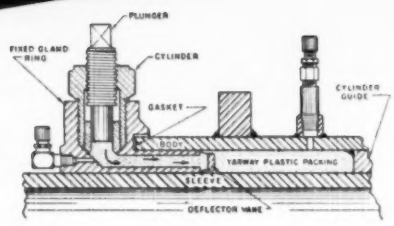
COST LESS

to maintain

require

NO SHUTDOWNS

for servicing



Close-up of cross-section showing detail of Gun-Pakt feature.

YARWAY

Maintenance costs are less because there's less maintenance.

In a nutshell, that's why more and more utilities, institutions and industrial plants distributing steam are turning to Yarway Gun-Pakt Expansion Joints.

Servicing Gun-Pakt Joints never interrupts heating or production. They are serviced under full steam pressure, without shutdowns.

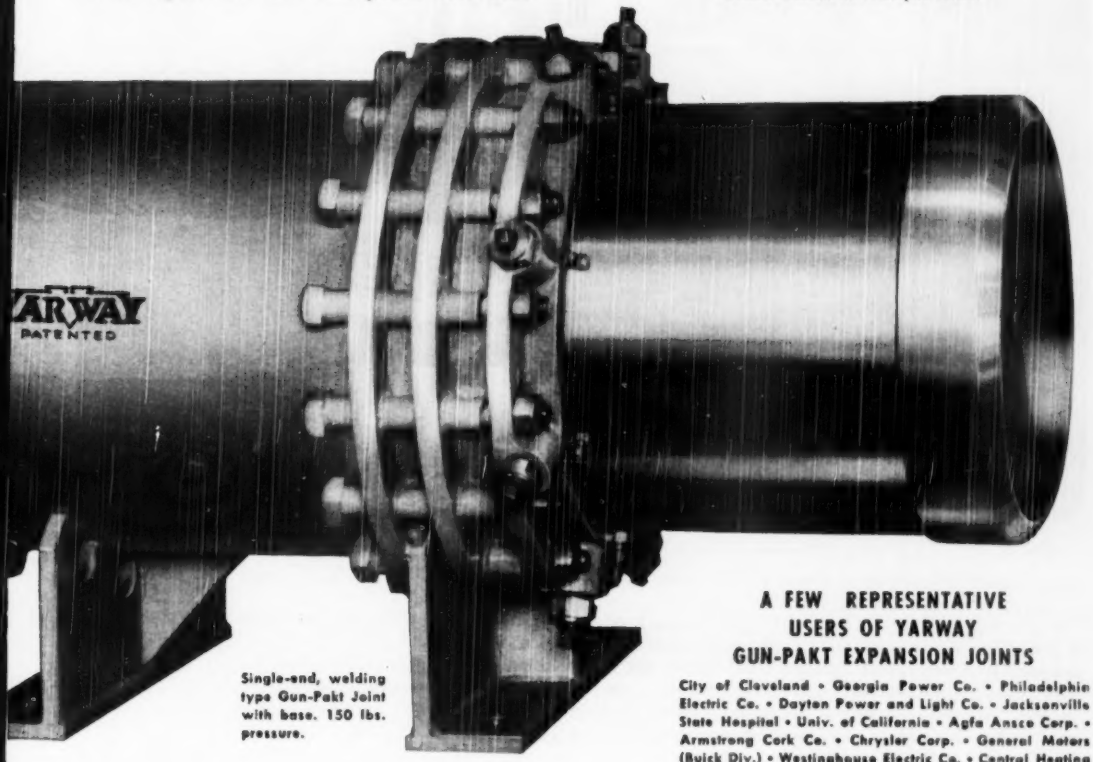
To repack a Gun-Pakt Joint you simply insert a plug of plastic packing, turn a wrench, and the job's done. Special Alemite fittings provide for proper lubrication.

Users report that Gun-Pakt Joints cost little to maintain. One who has kept accurate records says "65 cents per year per joint." Others claim even less.

Available with single or double ends, welding or flanged types, in sizes from 2" to 30", with traverses from 4" to 24", and for pressures to 400 psi.

For the full Gun-Pakt story, as well as information on other Yarway slip-type joints, write for Yarway Bulletin EJ-1912.

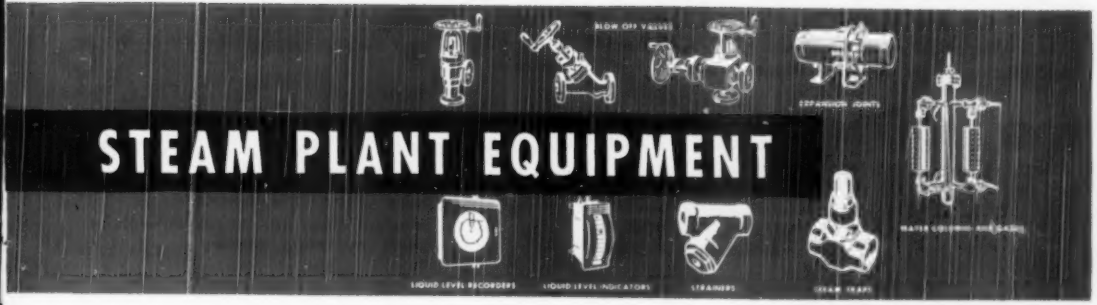
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities



Single-end, welding type Gun-Pakt Joint with base. 150 lbs. pressure.

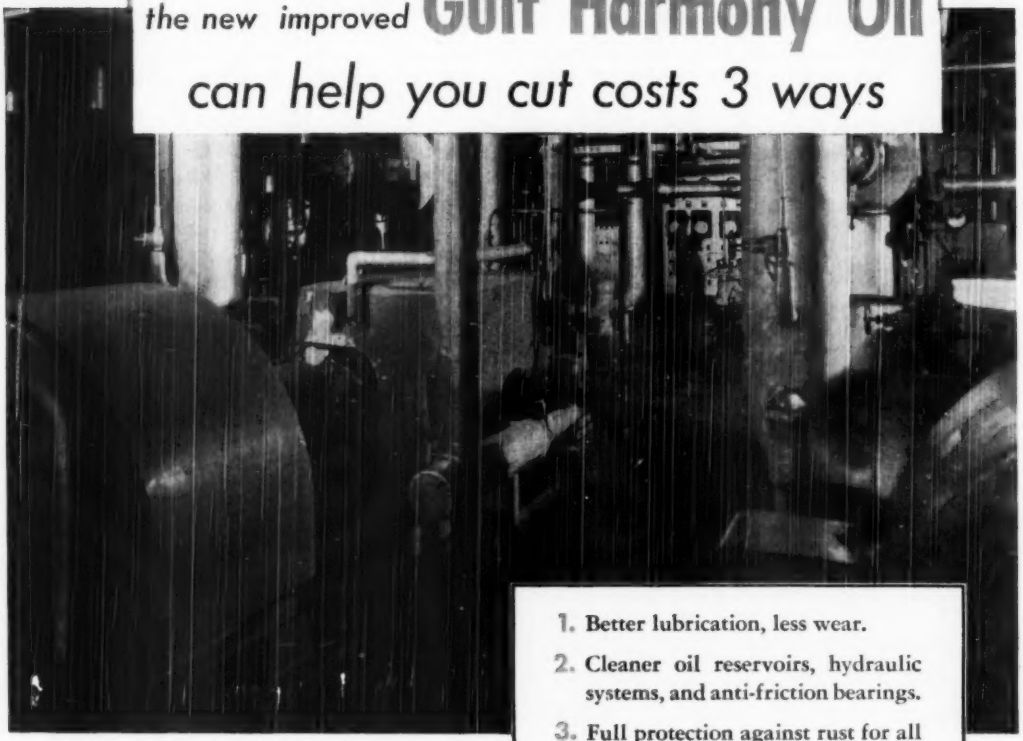
A FEW REPRESENTATIVE USERS OF YARWAY GUN-PAKT EXPANSION JOINTS

City of Cleveland • Georgia Power Co. • Philadelphia Electric Co. • Dayton Power and Light Co. • Jacksonville State Hospital • Univ. of California • Agfa Ansco Corp. • Armstrong Cork Co. • Chrysler Corp. • General Motors (Buick Div.) • Westinghouse Electric Co. • Central Heating Plant, Washington, D. C.



For pumps, compressors, and other oil-lubricated auxiliary equipment

the new improved Gulf Harmony Oil *can help you cut costs 3 ways*



1. Better lubrication, less wear.
2. Cleaner oil reservoirs, hydraulic systems, and anti-friction bearings.
3. Full protection against rust for all oil-bathed surfaces.

The new improved Gulf Harmony Oil provides the kind of protection that means lower maintenance costs and freedom from lubrication troubles. Users report that it is the best lubricant they have ever used for pumps, compressors, blowers, and other oil-lubricated plant equipment. They also report excellent performance in hydraulic applications.

Gulf Harmony Oil is enriched with a remarkable new oxidation stabilizer—another important Gulf Research development. This additive improves the already outstanding oxidation stability of Gulf Harmony Oil—gives it exceptional resistance to sludging. In oil lubricated bearings it far outlasts competitive oils.

Gulf Harmony Oil has been fortified to provide an even more effective rust preventive film. Now you can be sure of full protection against rust for all oil-bathed surfaces. It is particularly effective for ball and roller bearings operating under wet conditions. And it separates readily from water.

This outstanding oil provides more effective protection for bearings, gear units, hydraulic mechanisms and compressor cylinders. Available in a wide range of viscosities.

For more complete information on Gulf Harmony Oil, call in a Gulf Lubrication Engineer today. Write, wire, or phone:

GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation · Gulf Refining Company

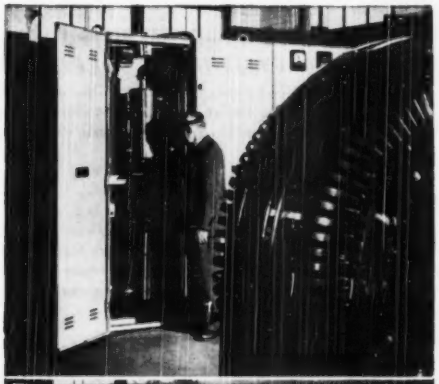
GULF BUILDING, PITTSBURGH, PA.

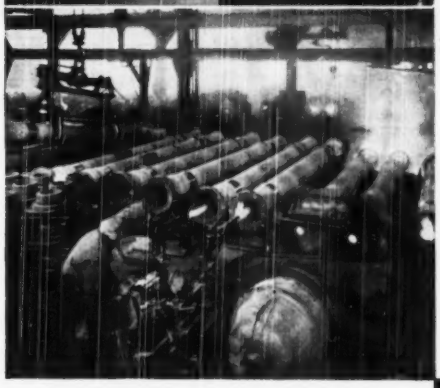
Sales Offices - Warehouses

Located in principal cities and towns throughout Gulfs marketing territory

$30,000 back in 5 years

The 500-kw, 250-volt G-E rectifier at the Florence Pipe Foundry and Machine Company requires only periodic inspection.





The G-E rectifier provides the d-c power which operates the cranes, ladles, and centrifugal casting machinery in the Florence Company's plant.

Florence Pipe Foundry & Machine Company

GETS LOW-COST D-C POWER WITH G-E RECTIFIERS

When the Florence Pipe Foundry & Machine Company needed additional d-c power in 1946, George E. Pfeffer, electrical engineer, looked for the best way to do the job. He learned that installing G-E rectifiers would save in three ways:

1. Installation costs—$10,000 less

The rectifiers were compact enough to fit into the present power house. Other types of generating equipment required the construction of a costly new building.

2. Operating costs—no new personnel needed

Because rectifiers need only periodic inspection, there's no need for standby personnel.

3. Power costs—$600 a year less

The extra high efficiency of G-E sealed rectifiers saves about $600 a year in power bills.

The combined savings will amount to $30,000 in five years. That will pay for the rectifiers, and for the cost of installing them.

To Cut your Power Costs

Find out today how you can put G-E power rectifiers to work in your plant. Call or write your nearest G-E sales office for information. **Apparatus Department, General Electric Company, Schenectady, N. Y.**

G-E MERCURY-ARC RECTIFIERS MEAN LOW-COST D-C POWER

GENERAL ELECTRIC

They're New!

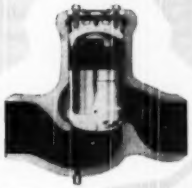
NEW PRESSURE SEAL BONNET VALVES.. NEW FORGED STEEL GLOBE VALVES.. NEW IMPACTOR HANDWHEELS.

SELF-SEALING BONNET JOINTS, 30% MORE FLOW

Now you can get Edward pressure-seal bonnet valves in gate, globe or angle patterns for stop, check or non-return service. New features for lower and lower pressure drop have been built in—and **proved.** On no other valve series is there more proven flow data.

EDWARD PATENTED EVALTHRUST YOKE BUSHING

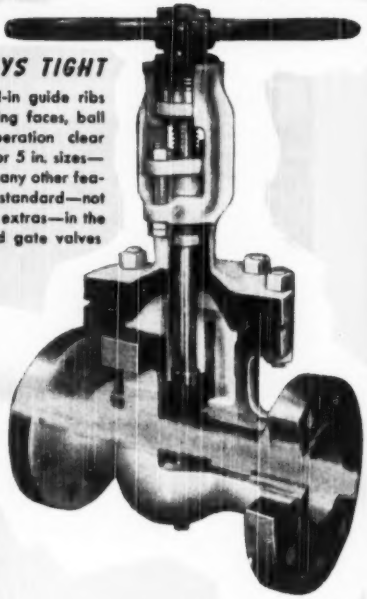
and Impactor handwheel for easiest closing in cramped locations is standard on stop and non-return series. So is closure indicator.



ON CHECK VALVE, left, and non-return valve, far left, note new enclosed dash-pot disk, Edward Equalizer for high disk lift and free flow passage. The whole series is regularly built in chrome-moly steels for stability at high temperatures.

GATE VALVE THAT STAYS TIGHT

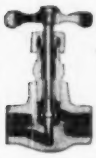
Welded-in Stellited seats, welded-in guide ribs to eliminate wedge drag on seating faces, ball bearing operation clear down to 4 or 5 in. sizes—these and many other features are standard—not added cost extras—in the new Edward gate valves



WANT MORE DATA? Special bulletins are now available on most of these designs. A few are so new that full catalog data isn't ready yet, but we can supply dimensional drawings. Ask your nearest Edward representative, or write direct to Edward Valves, Inc., East Chicago, Indiana.

A WHOLE NEW GROUP of Edward Steel Valve Designs

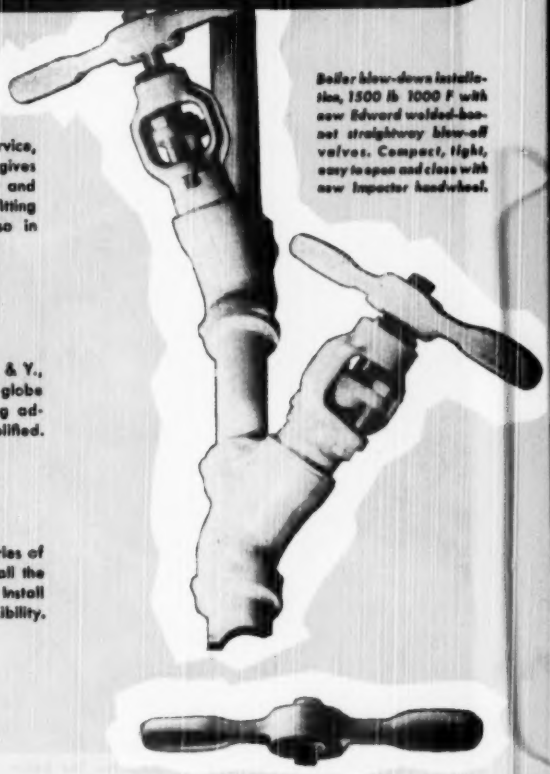
..NEW GAGE VALVES..NEW WELDED BONNET UNIVALVES..NEW BLOW-OFF VALVES...NEW GATE VALVES



FINE REGULATION ON GAGE LINES For gage and meter service, the redesigned Edward Fig. 152 valve gives close flow regulation with small seat port and longer seat-stem contact area. New form fitting T-Handle. Rated 4000 lb W.O.G. Also in 12% Cr. and 18-8 stainless steels.

ALL-PURPOSE SMALL GLOBE VALVE Here's a new O. S. & Y., union bonnet, bolted gland forged steel globe valve for a multitude of services. Packing adjustment or replacement greatly simplified. Rated 800 lb, 750 F.

BLOW-OFF FLEXIBILITY A new series of 300 lb O. S. & Y. blow-off valves with all the design features of high pressure valves. Install them in any position for greatest piping flexibility.



Boiler blow-down installation, 1500 lb 1000 F with new Edward welded-bonnet straightway blow-off valves. Compact, tight, easy to open and close with new Inspector handwheel.

NEW, EASIER CLOSING Now the Edward Inspector handwheel, modernized and improved, is available on many small valves as well as large. Easy-to-grip cross bar delivers 2.8 times the closing load of ordinary handwheels. No wrenches or extension bars needed.

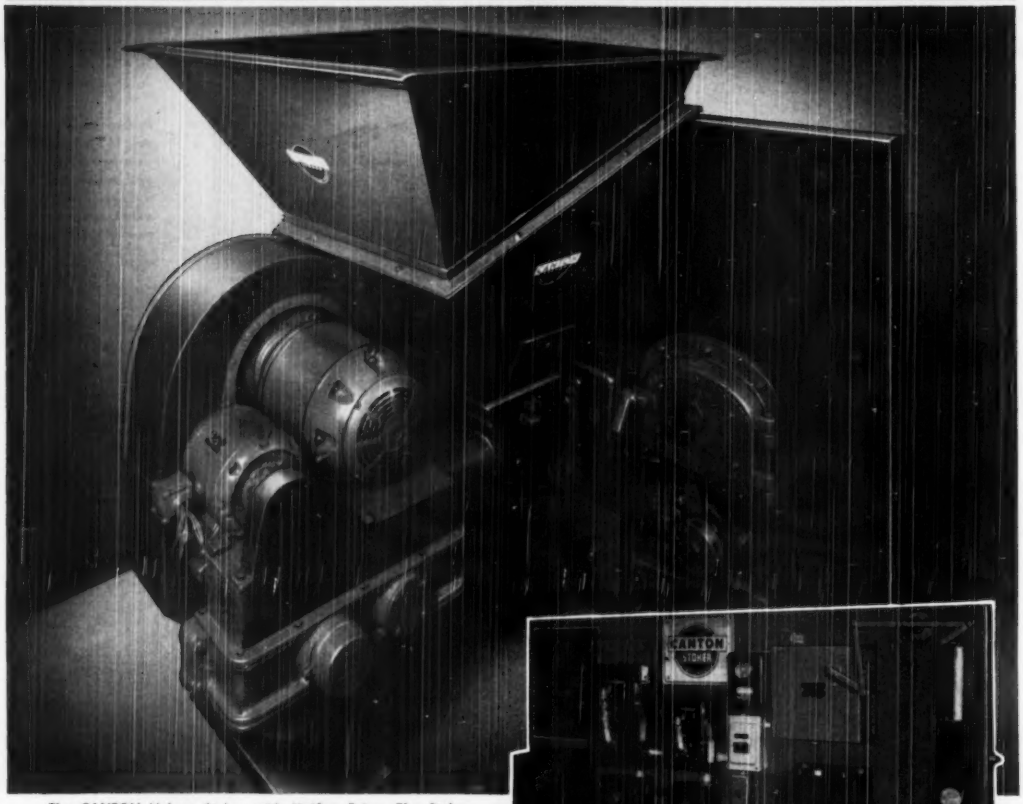
NEW WELDED-BONNET UNIVALVE

Already lowest in pressure drop among forged steel globe valves, Edward patented welded bonnet Univalves have been modified to give even less resistance to flow, less wear-producing turbulence. For top temperature service and up to 2500 lb pressure, here is the valve that offers the most.

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO. EAST CHICAGO, INDIANA

CANTON DEPENDABILITY



The CANTON Vulcan Stoker with Uniflex Drive. The Stoker and Blower are mounted at the front of the boiler, but retain the flexibility of separate control of blower and stoker.

CANTON Control Panel Board. All automatic equipment necessary to each installation is mounted and wired at the factory—delivered to the job as a single complete unit.

CANTON

SINCE 1910

COSTS YOU NOTHING!

CANTON STOKERS

There is no substitute for dependability—especially in a stoker, where your best value is found in the dependability of the equipment and of the company that produces it.

The four-way dependability "built into" Canton Stokers is the chief reason for its wide acceptance among consulting engineers, architects, operating engineers, and owners.

DEPENDABILITY OF ENGINEERING—Canton makes no "general-purpose" equipment, each installation being carefully designed and engineered to the specific requirements of the user.

DEPENDABILITY OF MANUFACTURE—From the selection of the finest materials and components through every step of manufacture and testing, Canton Stokers are fabricated and assembled with the greatest care and precision.

DEPENDABILITY OF OPERATION—Precision engineering and manufacture plus the use of top-grade components provide Canton Stokers with every property necessary to long, efficient operation and lower maintenance cost. This dependability has been repeatedly acknowledged by thousands of satisfied users during the past forty years.

DEPENDABILITY OF SERVICE—Canton maintains a complete service organization for prompt maintenance service anywhere, any time. This assures operators a minimum of downtime for their stoker equipment.

Add to these advantages the fuel savings accomplished and you have another reason why thousands of users are "sold" today on Canton Ram and Worm Feed Stokers for all types of power generating and heating plants.

CANTON STOKER CORPORATION
Andrew Place, S. W., Canton, Ohio
CANADIAN REPRESENTATIVE: Volcano Ltd., 743 Mountain Street, Montreal 3, Quebec
EXPORT DIVISION: W. B. Harkins, 751 Drexel Building, Philadelphia 6, Pa.

For detailed information on Canton Stokers, call or write the Canton Stoker representative nearest you or Canton Stoker Corporation, Canton 1, Ohio. *Bulletins on Request.*

Multiple CANTON LoSet Stoker Installation with Overhead Coal Feed at J. Weller Company's Cannery, Oak Harbor, Ohio.

Three CANTON LoSet Stokers used by the General Hosiery Co., Ft. Wayne, Indiana.

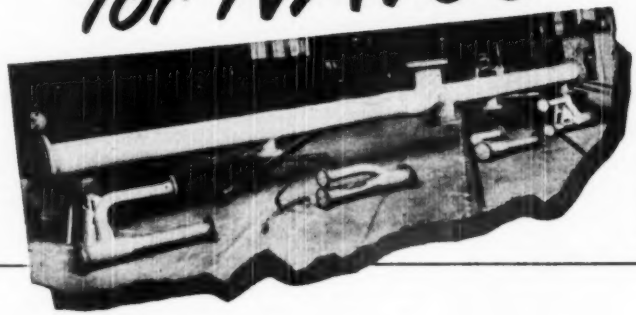
Multiple CANTON Vulcan Ram Feed Stoker Installation at Utah State Capitol, Salt Lake City.

CANTON RAM FEED STOKER DRIVE MECHANISMS ARE GUARANTEED FOR FIVE YEARS

STOKER

CANTON STOKER CORP. CANTON 1, OHIO

No job is too unusual for NAVCO



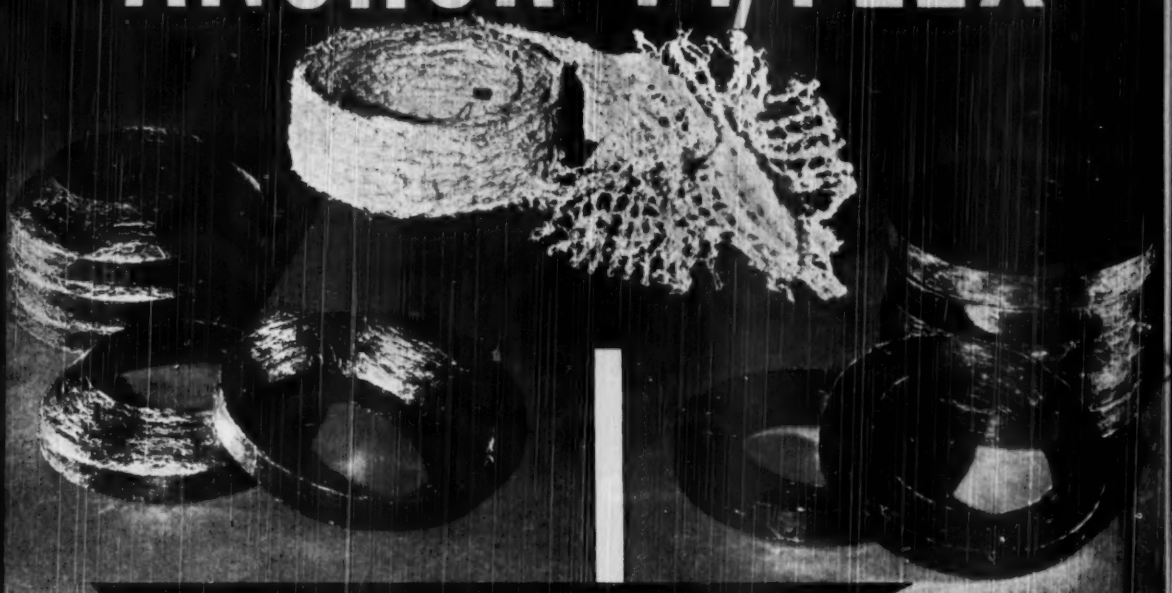
Whether you require a simple pipe bend or a complicated prefabricated assembly Navco can help you. As shown above, Navco Shops are equipped to handle Chrome Moly, Stainless, Carbon Steel and Copper, in addition to any of the many other Ferrous and Non-Ferrous materials.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

ANCHOR VY/FLEX



. . . A Flexible Metallic Packing That Withstands HIGH Pressures . . . and HIGH Temperatures . . .

MODERN power-operated machines have created a demand for packings capable of giving service on greater pressures and temperatures than ever encountered. To meet such a need comes Anchor VY/FLEX, a highly specialized packing designed by The Anchor Packing Company to withstand the operating elements where many other packings have failed. VY/FLEX withstands most high pressures and high temperatures . . . is adaptable to a wide variety of uses. Write us today for full details.

RECOMMENDED FOR:

- POWER PLANTS AND STEEL MILLS
- RAILROADS
- CHEMICAL PLANTS
- IN THROTTLE VALVES, REDUCING VALVES, HOT BLAST VALVES
- WATER COLUMN GASKETS
- TAR
- ASPHALT AND ACID PUMPS
- HIGH TEMPERATURE GASES
- AIR COMPRESSORS
- EXPANSION JOINTS
- OIL REFINERIES

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THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

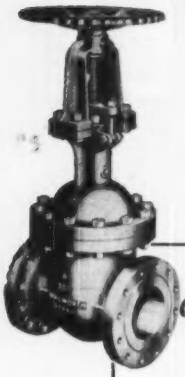
FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

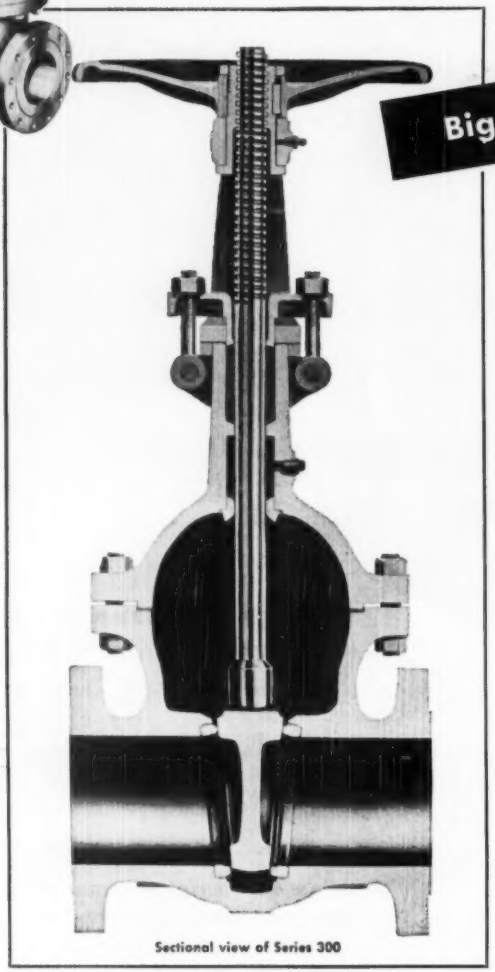
WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2" to 24") insure tightness and maximum packing life – costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

IMPROVE COAL HANDLING *Three* WAYS...

...with VERSATILE ALLIS-CHALMERS TRACTORS

1. ADD FLEXIBILITY. Store coal wherever there is available space . . . and reclaim it any time. A-C crawler tractors, equipped with loaders, bulldozers or scrapers travel anywhere . . . over any ground. And in rush periods, you can speed up operations temporarily by transferring additional tractor units to the job.

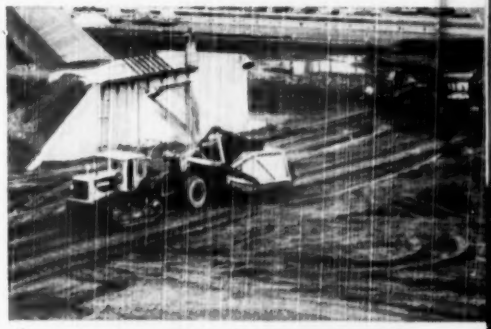
2. HAVE EXTRA FIRE PROTECTION. When A-C tractor units store coal, they spread it in thin layers and compact it by constant travel over the pile. The tight packing of horizontal layers eliminates the flues that cause spontaneous combustion in loose conical piles.

3. REDUCE EQUIPMENT INVESTMENT. The Allis-Chalmers tractor method is considerably more economical and flexible than complex conveyor or crane systems — which means savings in original cost as well as lower cost per ton for coal handling. And tractor units can also be used for such jobs as plant and yard maintenance, material handling, car spotting and snow removal.

Your Allis-Chalmers dealer will be glad to demonstrate the advantages of modern coal handling with A-C tractors . . . to take care of all storing and reclaiming — or to supplement existing equipment. See him now or write direct for complete information.

Four Diesel-Powered Models . . . 11,000 to 40,000 lb.

HD-5G Tracto-Shovel stockpiling coal at a large industrial plant in Cleveland... has averaged 2500 tons a month for a year and a half without ever being down for repairs.



Four A-C tractors with Gar Wood scrapers bring real flexibility to the coal handling operations of an Ohio utility. They haul as far as 1,700 feet . . . store wherever there is available space.

"SEEING IS BELIEVING" — ASK YOUR ALLIS-CHALMERS DEALER FOR A DEMONSTRATION

For Greater Production
For Easier Operation
For Simplified Servicing

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

Sinclair Rubilene Resists Oxidation Gives Long, Low Cost Service

Oxidation attacks oil wherever there is continuous recirculation—in enclosed crankcase systems and, especially, in central circulating systems. It forms damaging acidic compounds, gum, carbon, and sludge. Result: frictional drag is increased, oil lines may become restricted or closed, wear accelerated, efficiency and life lowered.

Many years of experience show Sinclair Rubilene successfully withstands oxidation even under sustained high temperatures. This is due to Rubilene's greater stability and ruggedness. At the same time non-foaming Rubilene assures a solid flow of oil to provide a tough oil cushion between all moving parts. Rubilene thus lessens friction and wear and provides high efficiency and smooth operation.

Why not eliminate worry over damaging oxidation and assure reliable lubrication? Use Sinclair Rubilene Oils.

Your nearest Supplier of Sinclair Products will gladly arrange for lubrication counsel, or write to Sinclair Refining Company, 630 Fifth Avenue, New York 20, N. Y.

SINCLAIR

Sustained New-Oil Quality
Long Oil Life
Tough Oil– Less Wear
Circulates Freely
INDUSTRIAL OILS

Avoid "DOWN-TIME" Standardize on the

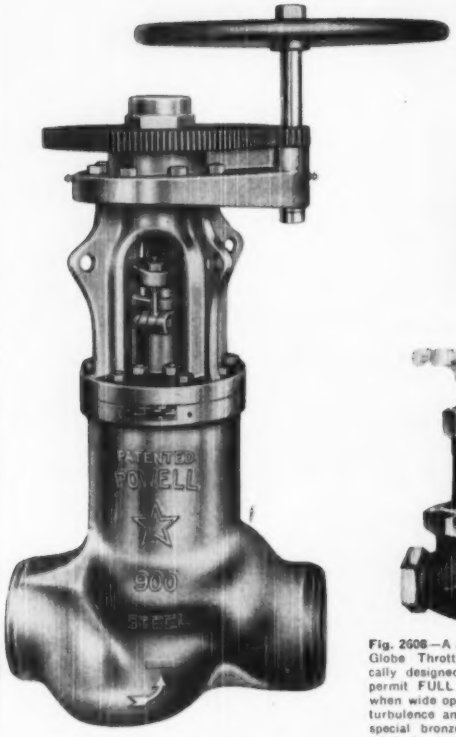


Fig. 19084 W. E.—Class 900-pound Cast Steel Pressure Seal Globe Non-Return Valve with welding ends and spur gear operation. Its improved streamline design reduces pressure drop and turbulence to the minimum.

Fig. 2608—A new 200-pound Bronze Globe Throttling Valve. Scientifically designed and proportioned to permit FULL FLOW through seat when wide open, greatly minimizing turbulence and pressure drop. Has special bronze stem and stainless steel disc and seat hardened to approximately 500 Brinell.

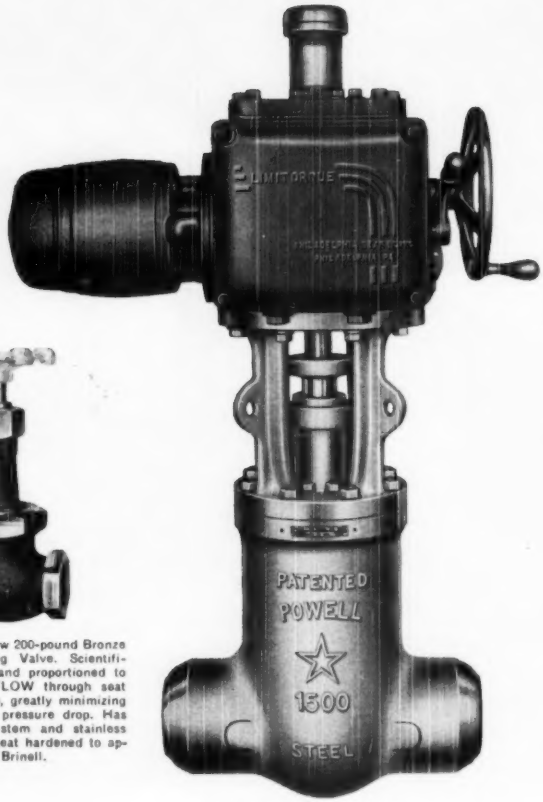


Fig. 11323 W. E.—Class 1500-pound Cast Steel Pressure Seal Gate Valve with welding ends. Has top-mounted electric motor operator for quick positive opening and closing.

POWELL

for Maintenance — POWELL LINE

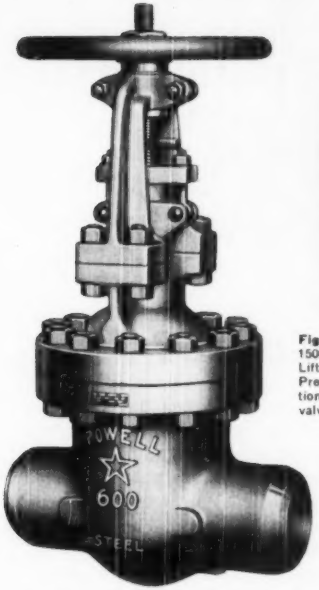


Fig. 6003 W. E. — Class 600-pound Cast Steel Gate Valve. Welding ends, bolted flanged yoke, outside screw rising stem, tapered solid wedge.

Fig. 1367-A—Small size, 1500-pound Steel Angle Lift Check Valve with Pressure Seal construction. "Y" type lift check valves also available.

When you buy a valve, ask yourself these two questions. First, will it operate satisfactorily in the service in which it is to be used? Second, how much *maintenance* will it require? Because, when maintenance becomes necessary, there's a two-fold cost. One, the cost of labor—and possibly parts—to put it back in working order. Two, the loss of production farther down the line.

And, because Powell Engineers have this constantly in mind, every valve in the *complete* Powell Line* is designed and made to avoid, as far as possible, "DOWN-TIME" for maintenance.

That's why, through the years, Powell Valves have been noted for long, trouble-free performance—even under the most exacting service conditions.

Fig. 1314-A — Class 1500-pound Steel Integral Bonnet "Y" Valve. Also made in Globe and Angle patterns.

Fig. 559 — 125-pound Iron Body Bronze Mounted Swing Check Valve with flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc.

*The Complete Powell Line includes Globe, Angle, "Y", Gate, Check, Non-return, Relief, and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-resistant metals and alloys.

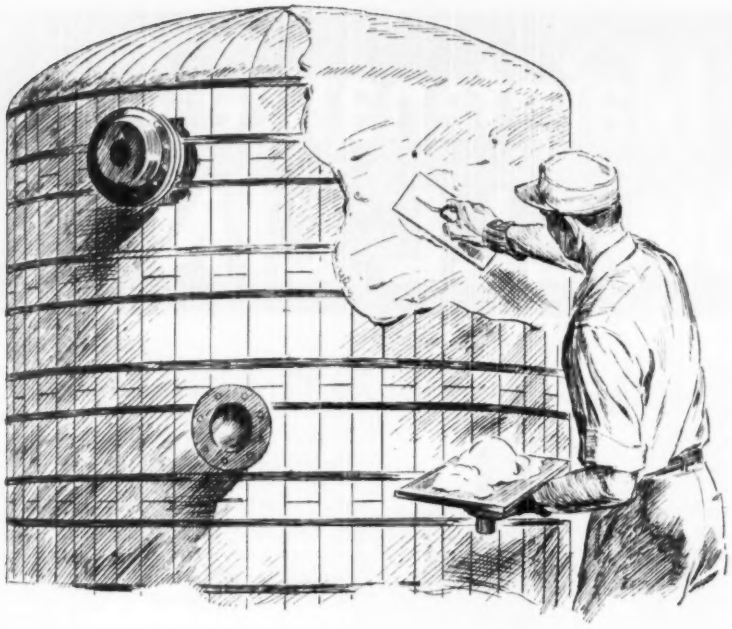
Ask your nearest Distributor—or write direct

The WM. POWELL Co., 2525 Spring Grove Ave.

P. O. Box 106, Station B, Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

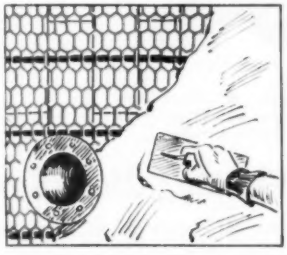
VALVES



What's wrong with this picture?

Here is a workman applying cement finish over the insulation on a boiler water heater, but he has omitted one very important step. For a good job, a layer of hexagonal wire mesh should have been placed over the insulation before the cement finish was applied. Here's why this is important.

Over very small areas, insulating cements will adhere well enough to heat insulating materials. But on larger equipment and fittings, even though some key is afforded by bands or wires that hold the insulation in place, this is far from sufficient to anchor the finish for any length of time. A layer of wire mesh provides the key necessary for a tight job. It also distributes evenly the effects of expansion and contraction after the equipment goes into operation, thus reducing cracks in the finish.



The wire mesh over insulation on larger size equipment is just an example of how unseen details can add to the efficiency and life of a heat insulation job. Being sure every detail, both seen and hidden, is done right is one of the things you can count on when you hire a reliable contractor. Armstrong has established a reputation for reliable workmanship, and close attention to detail.

When you call on Armstrong's contracting organization you get the expert engineering advice and skillful application of high-quality insulation that insures a good job. Why not ask Armstrong for an estimate on your next heat insulation work? There's no obligation. Just phone the Armstrong office nearest you or write to Armstrong Cork Co., 7008 Maple Ave., Lancaster, Pa.

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS - INSTALLATION

FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2800°F.

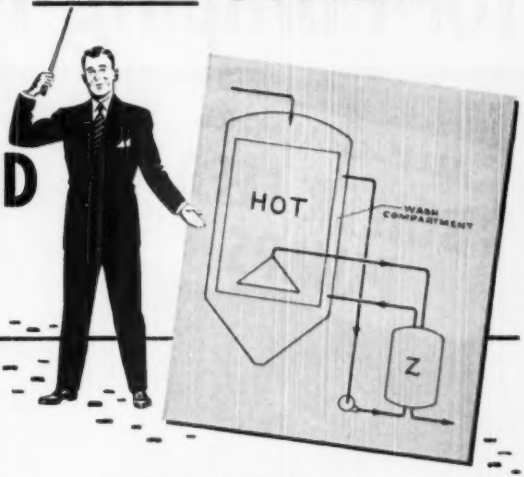
REVOLUTIONARY

advance in boiler feed water treatment!

WORTHINGTON HOT-Z SYSTEM

combines all the best features of

HOT PROCESS AND ZEOLITE



Choosing between Hot Process and Zeolite is no longer a boiler feed water problem. The Worthington Hot-Z System gives you the advantages of each system including deaeration.

SEE WHAT HOT-Z DOES FOR YOU:

1. Reduces hardness to 0.2 ppm without addition of excess soda alkalinity.
2. Operates on cheapest chemicals — lime and salt.
3. Saves enough in chemical costs to pay for average installation in 3 years.
4. Offers easy control when operating on variable waters.
5. Removes oxygen to 0.005 cc per litre.
6. Makes cumbersome two-tank lime-soda-phosphate systems obsolete.
7. Includes ideal facilities for the necessary hot clear water zeolite washing process.
8. Makes filters unnecessary except in special cases.
9. Does away with vent condenser scale.
10. Reduces phosphate precipitates in boiler to unobjectionable amount.
11. Reduces silica.

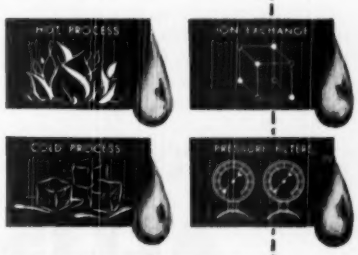
INVESTIGATE! If you are now considering split treatment, hold up your decision until you examine the Worthington Hot-Z System. Tell us your conditions of service and get our recommendation in terms of dollars and benefits. You'll find in our Hot-Z System, as in so much other equipment, *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Division, Dunellen, N. J.*

JO-4

WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



A Single Responsibility for Pumping Performance!

FOR EASTERN UTILITY—one of three 5x5, 12 stage Allis-Chalmers Barrel Boiler Feed Pumps rated 227,000 lbs/hr (480 gpm) 1750 lbs/hr 0° G., driven by 3575 rpm, 800 hp Allis-Chalmers squirrel-cage motors.

BEAT THIS KIND OF COMBINATION — *at any price:* An excellent quality boiler feed *pump,* high reliability *motor,* and complete *control*— all Allis-Chalmers built and backed!

You save time and money in negotiation, installation and operation.

ASK THE POWER PLANT USER!

Regardless of which of the 3 Allis-Chalmers boiler feed pumps described at right you finally settle on, here's the kind of *maintenance* operational record you can expect and get when you invest in A-C:

EASTERN UTILITY, 735 gpm pumps, "after 45,000 hours no measurable wear on shaft sleeves, rings or internal parts."

MIDWEST UTILITY, 6 x 4, 5-stage pumps, "After 82,000 hours not .001 inch wear on any internal part."

OHIO UTILITY re-ordered three 1800 p.s.i. pumps on strength of this performance — "Only .002 inch wear on rings after 8 years operation on pumps."

And on the motor end, a midwest Utility reports, "in over 20 years of uninterrupted service with three, 800 hp, two-pole motors driving boiler feed pumps we've had to order replacement parts just twice at a total cost averaging less than $12 a year!"

CHOOSE FROM 3 TYPES PUMPS:

☛ Barrel-type, for larger steam stations operating against the higher pressures, 1200 to 2500 lbs; 300 to 2000 gpm.

☛ "Doubleton," for pressures between 1200 and 1800 p.s.i.

☛ Standard Type "M," for pressures usually under 1200 p.s.i.

BENEFITS OF "PACKAGE" INVESTMENT

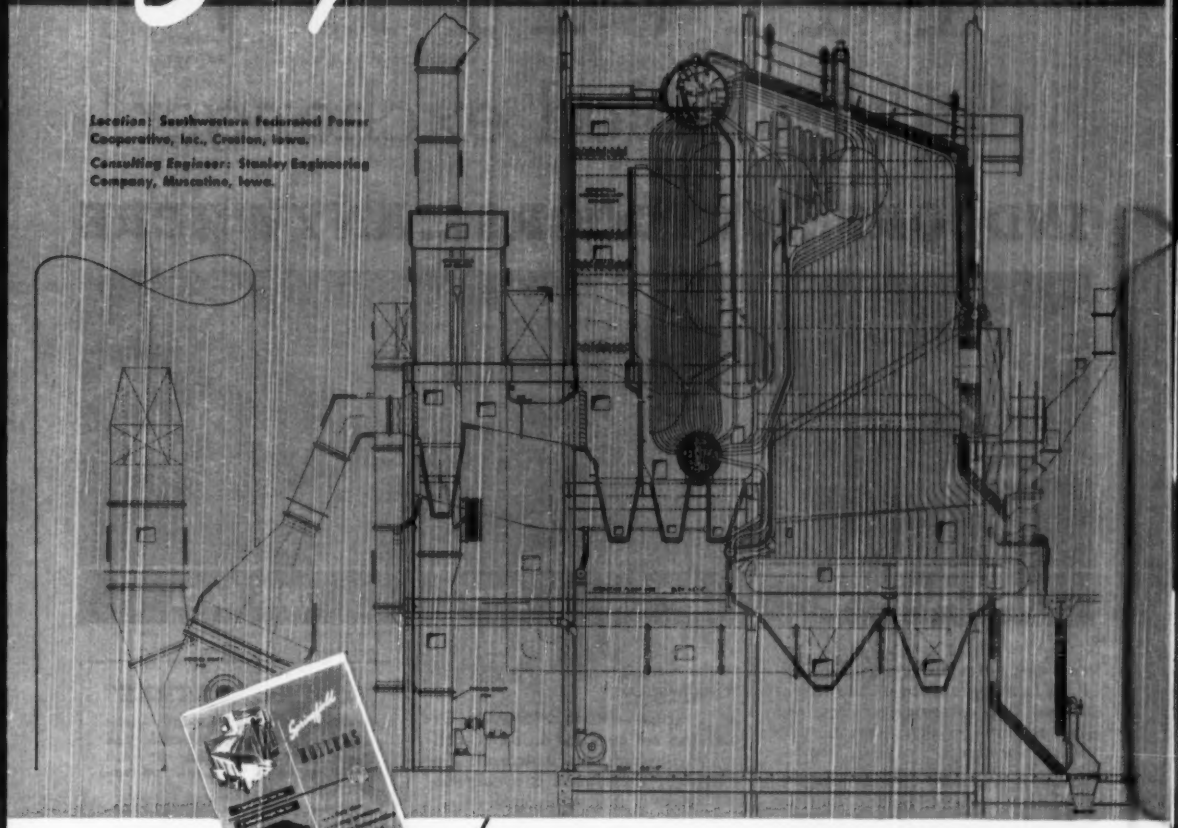
Yes, for *quality* performance in *your* power plant, get hold of an Allis-Chalmers pump application engineer today. He's an *expert* at figuring requirements at the economy point. And he's ready to show you *where* and *how* a complete Allis-Chalmers "Power Plant Pumping Package"... pumps, motors, control, will keep you ahead in time, performance, and freedom from worry. A-3040

ALLIS-CHALMERS, 952A SO. 70 ST. MILWAUKEE, WIS.

ALLIS-CHALMERS

SPRINGFIELD *Engineered!*

TO MEET USER'S REQUIREMENTS



Location: Southwestern Federated Power Cooperative, Inc., Creston, Iowa.

Consulting Engineer: Stanley Engineering Company, Muscatine, Iowa.

See our catalog in SWEET'S

FINEST ENGINEERING is reflected in Springfield designs for complete steam generating units produced to meet the user's individual requirements. The design shown here is a typical example of the *plus value* offered by Springfield. This is one of two new 100,000 lbs.—700 p.s.i. units for the Creston, Iowa, station of the Southwestern Federated Power Cooperative, Inc. In service, each unit is designed to operate continuously at 90,000 lbs. per hour and 610 p.s.i. pressure with 825°F. total steam temperature at superheater outlet. Firing is by spreader stoker with burners also installed for use of gas as auxiliary fuel.

Capitalize on Springfield's skill and 60 years of continuous specialization in boilers! See your local Springfield representative or write.

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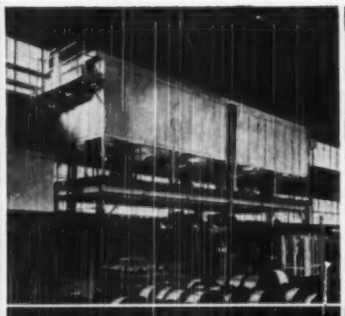
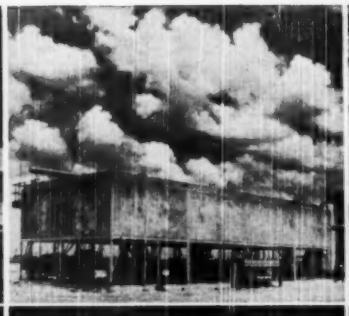
CHECK WITH YOUR CONSULTING ENGINEER ON MODERNIZATION AND NEW PLANT PROJECTS

You can put FIN-FAN the air-cooled exchanger

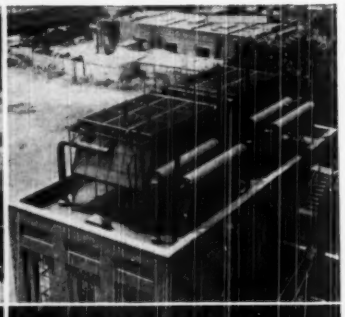
INDOORS...OUTDOORS...ANYWHERE



IN A BUILDING



ON THE GROUND



ON A ROOF

YOU CAN PLACE the *air-cooled* FIN-FAN Exchanger at any convenient location. It is compact, self-contained and requires neither cooling-water piping nor natural draft.

WITHIN A BUILDING—You can install a FIN-FAN on or above the floor. In one large industrial plant, the FIN-FAN unit was elevated to leave the floor free for a tool room.

ON THE GROUND—When indoor space is limited, you can place a FIN-FAN Exchanger outdoors without affecting its efficiency in any way. Because it uses forced draft, the unit develops its own positive air circulation, which is independent of the surrounding air or the direction and velocity of prevailing winds.

ON A ROOF—Many FIN-FAN Exchangers are installed on roofs without overloading the structures. The weight of these units is evenly distributed over their entire area.

This installation adaptability is only one of the many important advantages of FIN-FAN Exchangers, developed jointly by Fluor Corporation Ltd. and The Griscom-Russell Co. The panel at right mentions additional distinctive features. For complete information, write for Bulletin 1231.

FIN-FAN "EXTRAS"

WIDE RANGE OF SERVICES—It is suitable for cooling liquids and gases and for condensing vapors at pressures up to 5,000 psi. and temperatures up to 1500F.

ELIMINATES COOLING WATER PROBLEMS—You avoid all the complications and expenses of a water supply system . . . no water piping, pumps, treatment, disposal or make-up; no corrosion, scaling, freeze-ups, or structural repainting due to the use of water.

SERVES TWO OR MORE FUNCTIONS—You can use a single installation for two or more cooling and condensing duties simultaneously.

THE GRISCOM-RUSSELL CO. • 285 MADISON AVENUE, NEW YORK 17, N. Y.

GR-236

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

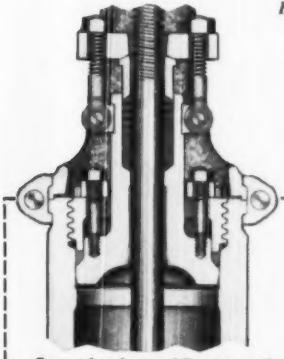
Why such preference for CRANE Pressure-Seal Bonnet Valves?

In power plants of all sizes . . . here and abroad . . . Crane Pressure-Seal Bonnet Valves are today regarded as standard equipment. By their performance alone they've earned such recognition. For these valves—with typical, dependable Crane Quality design, construction, and materials—have overcome the major problems of controlling high pressure steam.

Most important, of course, is their revolutionary bonnet sealing principle, eliminating bonnet joint leakage and bonnet joint maintenance. Substantially smaller and lighter than conventional valves, these valves are easier to handle . . . save on erection costs. New flexible disc gives easier operation. Streamlining of body design minimizes operating stresses . . . simplifies application of insulation.

Crane Pressure-Seal Bonnet Valves are made in gate, globe, angle, and stop-check patterns. They can be used in old plants as well as new. Get descriptive circular AD1819 from your Crane Branch or Wholesaler.

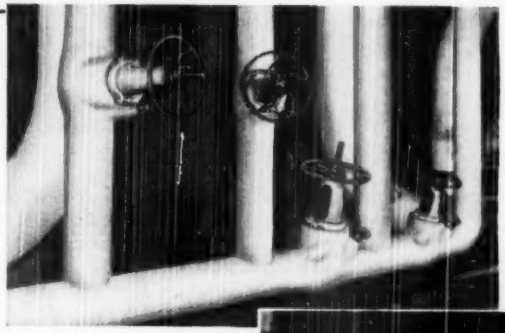
CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



Crane Leakproof Pressure-Seal Bonnet Joint Principle

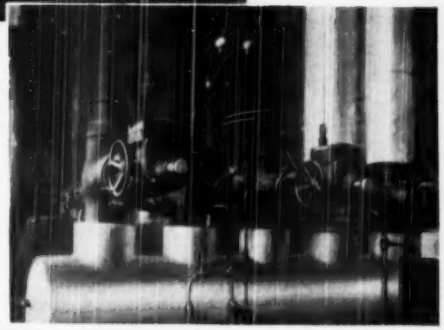
The bonnet joint as shown above is inside the valve, and the sealing element is a wedge-shaped seal ring. Internal fluid pressure, acting upon the entire underside of the bonnet, forces the bonnet against the seal ring; this wedges the metal seal ring between the body and bonnet, forming a pressure-tight metal-to-metal joint.

Typical installations demonstrating the superiority of Crane Pressure-Seal Bonnet Valves for high pressure power piping.



BOILER FEEDWATER HEADER *in large central station equipped with Crane 900-Pound Pressure-Seal Bonnet Gates and Angle By-pass Valves.*

Y-Pattern Globe 1500-Pound. Sizes: 1 to 4-inch.
Gate Valve 600, 900, and 1500-Pound. Sizes: 1 to 24-inch.
Angle Stop-Check 900 and 1500-Pound. Sizes: 6 to 12-inch.



PARIS, FRANCE . . . *Crane 1500-Pound Motor-Operated Pressure-Seal Bonnet Gates, on main steam header in a new central station.*

EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

FOR HIGH EFFICIENCY WITH VARIABLE FAN OUTPUT

THE NEW Sturtevant VANE CONTROL

Sturtevant Vane Control has been universally accepted as the economical way to obtain variable fan output at high efficiency. It provides instantaneous regulation of output for fans driven by constant-speed motors. In addition, it offers substantial power savings over other types of control at the high ratings at which most of today's boilers operate.

Easily Operable—Vane Control is a simple mechanism which remains easily operable under hot and cold conditions. Notice in the illustration how a cast-iron closure which fastens to the cone of the inlet box completely shrouds the center mechanism from the gas stream.

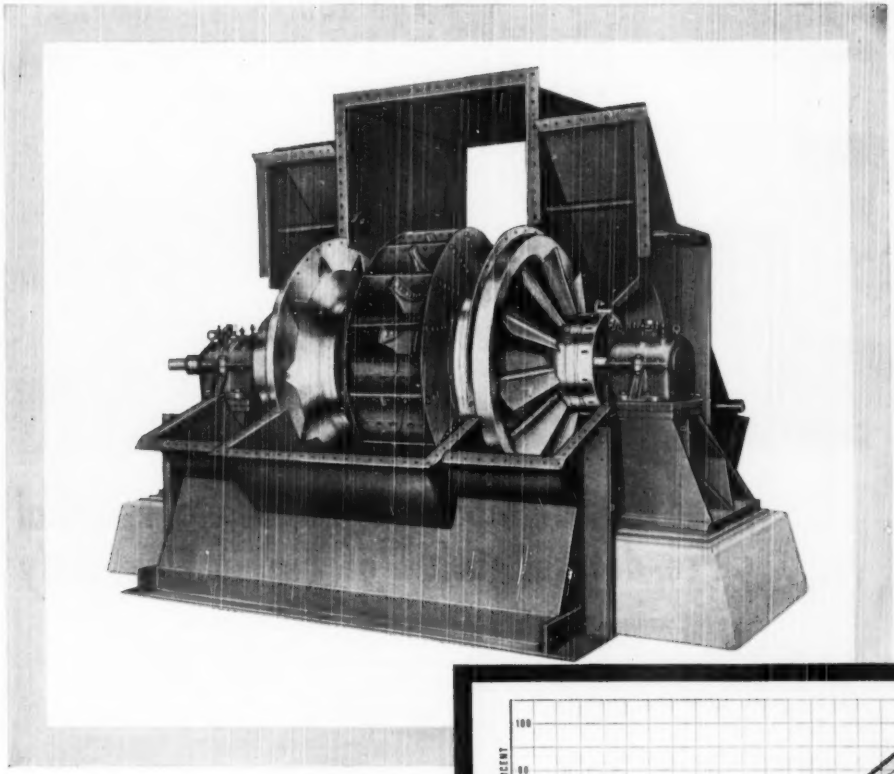
Full Fan Performance—Vanes are pivotted along conical elements to provide sufficient free area to achieve full fan performance when wide open. This conical arrangement of heavy cast or die-formed parts insures extreme rigidity to resist thrust loads.

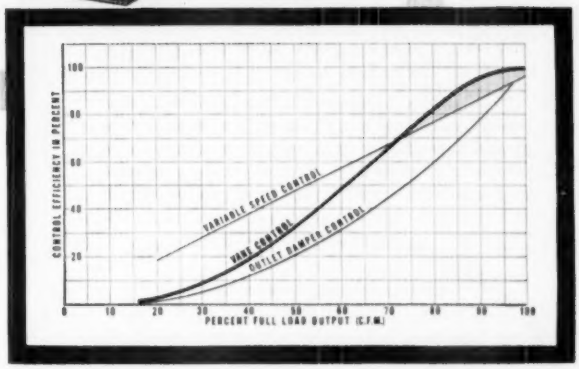
Link and Lever Action—The mechanism operates to give synchronized motion to vanes by link and lever action without the use of gears. Linkage from the operating shaft to the vane center is designed to effect a more rapid motion of vanes in the open range, and a slower motion in the near-closed position where finer adjustment is desired.

No Lubrication—No lubrication is necessary on any of the interior mechanisms of the control. Arrangement permits easy accessibility of all parts for inspection and maintenance.

For full information on Vane Control, write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.

Cutaway of a Sturtevant Induced Draft Fan, showing Vane Control shielded from the gas stream but open to access from the outside, and the Sturtevant E-R (Erosion Resisting) Wheel.





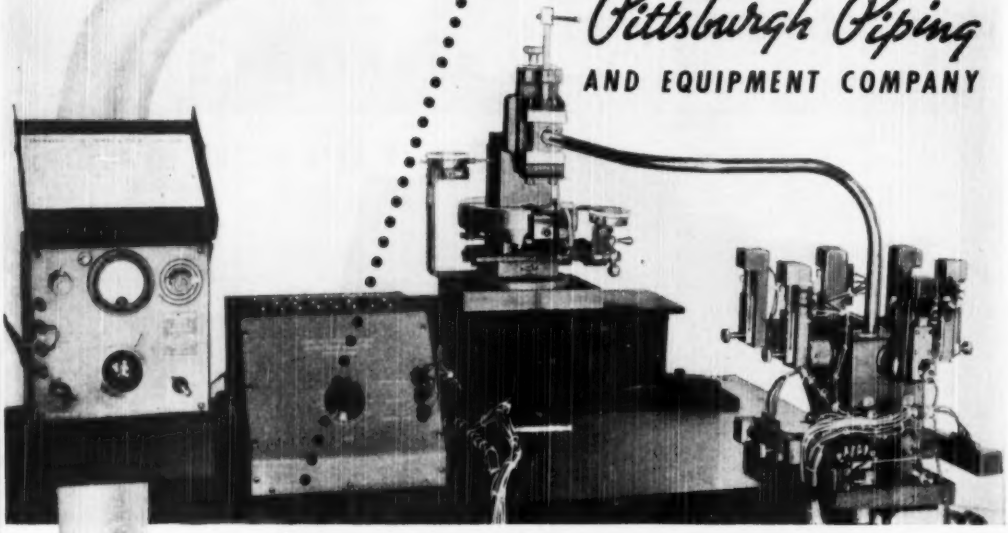
The comparison of control devices can best be shown by the relative "efficiencies" of the controls. Notice the "plus" region of Vane Control shown by the shaded area.

YOU CAN BE SURE...IF IT'S

Westinghouse

J-80192-A

Model Testing at Pittsburgh Piping AND EQUIPMENT COMPANY



The Modern Method for Complete, Practical Pre-determination of Piping Flexibility

Model testing is one of the many technological advancements thoroughly investigated and proved by Pittsburgh Piping and Equipment Company before being made generally available. It provides complete advance knowledge of the reactions of any type, size, and system of power piping.

The testing apparatus shown above accurately measures and directly indicates the physical reactions of a section of pipe which exactly duplicates, in miniature, the planned layout. These measurements are projected to give precise information on the full size system as a check against theoretical calculations.

On complex piping layouts, model testing provides a complete analysis instead of theoretical approximation; it is a time and labor saver; and the possibility of mathematical error is minimized. Its use helps to avoid excessive stresses, reactions, and movements in the final system which could affect joints and thus cause leakage, or damage anchors and equipment connected to the pipe line.

Look to Pittsburgh Piping and Equipment Company for leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

Model Testing makes possible the planning of high-pressure, high temperature piping systems with accurate advance knowledge of end reactions, stresses, and strains encountered in actual operation.

Pittsburgh Piping AND EQUIPMENT COMPANY

10 Forty-Third Street — Pittsburgh, Penna.

Woolworth Building, New York
Whitehead Building, Atlanta
Book Tower, Detroit
525 Market Street, San Francisco
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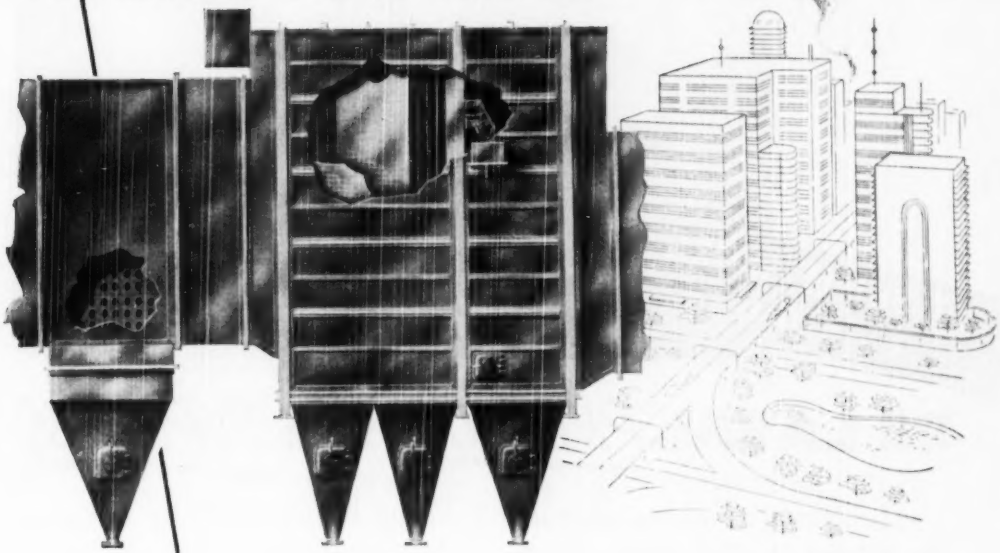
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston

engineered for the *Future*

THE AEROTEC SERIES COLLECTOR



Your dust collection equipment, a major investment, merits a thorough survey of the present trend toward more stringent dust ordinances.

To plan for the future, a collector should meet today's collection requirements, with provisions made for increasing the efficiency when dust ordinances become more stringent. It is well known that a mechanical collector is economical to operate. Such a collector therefore, that will meet present dust ordinance requirements and serve later as the primary to an electrical secondary, seems the logical choice.

The Aerotec Series Collector provides just this service. The primary, a highly efficient Aerotec Mechanical composed of multiple small diameter tubes, will meet most stringent dust ordinances in effect today. Should collection requirements be increased, the secondary, an Aerotec "Pocket-Type" Electrical Precipitator, is easily added to provide the finest in dust collection efficiency.

The Thermix Corporation, Project and Sales Engineers for the Aerotec Corporation, welcomes the opportunity to prove the sound engineering behind this arrangement . . . a combination engineered for the future.

Project and Sales Engineers

THE THERMIX CORPORATION

Greenwich, Connecticut

Canadian Affiliates: T. C. CHOWN, LTD., 1440 Saint Catherine St., W., Montreal 25, Quebec; 50 Abell St., Toronto 3, Ontario

THE AEROTEC CORPORATION

GREENWICH, CONN.

DE LAVAL *PROTECTS* the *TURBINES*

This De Laval centrifugal Oil Purifier installed at Philip Sporn Station provides positive protection for the turbines. It removes from the turbine oil sludge or any solid impurities that may be picked up, and it also separates and continuously discharges any moisture that may be in the oil.

Thus, the De Laval centrifuge provides ***two-way*** protection. It guards the power unit against ***both*** of the chief causes of lubricating oil contamination —dirt and water. Wholly mechanical in operation, De Laval Oil Purifiers are the logical choice of operators who want their oil to be really ***clean and dry***.

A wide range of capacities is available. Machines requiring separate pumps are provided in sizes having a purification capacity up to 1,000 gallons per hour. "Uni-Matic" machines, built with integral pumps, have a capacity up to 450 gph., Navy rating, on turbine oil (up to 550 gph. on certain other oils.)

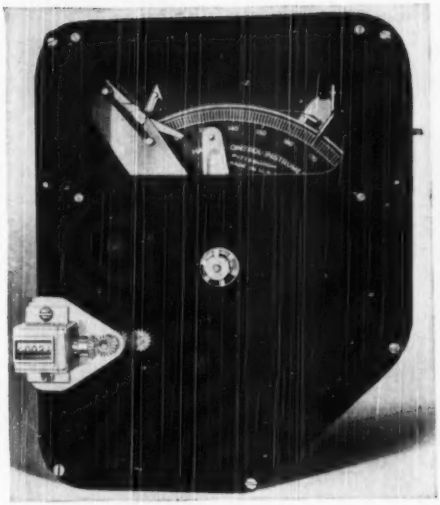
● Write for additional information.

De Laval

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

LUBRICATING OIL PURIFIERS

Accurate integration over the entire range in HAGAN



RING BALANCE METERS

This wide range accuracy is due to the unique design and precision construction of the Hagan integrator.

In this integrator, a large toothed wheel is set in motion periodically. The movement at each interval is governed by the flow index pen and is proportional to the momentary rate of flow. The wheel is geared to a counter which registers the total flow through any period, by difference in the counter readings.

The Hagan Integrator differs fundamentally from others in that all associated parts rotate around a common center. As a result, angularity errors are eliminated and only one simple adjustment is required for calibration throughout the range. The large five inch integrating wheel produces the required selectivity to integrate as low as two percent (of chart) with high accuracy. With this construction, wear between toothed wheel and the pawls is eliminated. There are no clutches to wear and slip.

The instantaneous pawl action also produces high accuracy under rapidly fluctuating flow conditions.

The graduations on the large wheel and pointer facilitate checking the calibration of the integrator at any point in the range in one minute or less.

The Hagan Integrator is a self-contained unit and may be mounted conveniently in any of the various types of Ring Balance flow meters, or pneumatic receivers.

For full information on this and other features of Hagan Ring Balance meters, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Penna.

HAGAN HALL BUROMIN CALGON

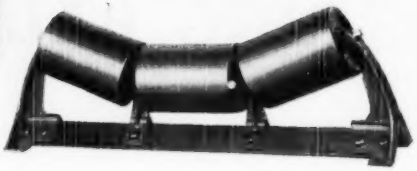
HAGAN CORPORATION

RING BALANCE FLOW AND PRESSURE INSTRUMENTS
THRUSTORQ FORCE MEASURING DEVICES
BOILER COMBUSTION CONTROL SYSTEMS
METALLURGICAL FURNACE CONTROL SYSTEMS

The Right Equipment · · · Engineering Experience · · · Background

Three most important requisites. Put them all together . . they spell RELIABILITY. Jeffrey has all three . . can put them to work for you . . can help you speed all sorts of material on its way. Single units or complete systems backed by sound engineering and over 70 years of experience. To do that material handling job exactly and economically . . call on Jeffrey.

- Apron Conveyors
- Belt Conveyors
- Bin Valves
- Bucket Elevators
- Car Pullers
- Coal Preparation Equipment
- Chains
- Coolers
- Crushers
- Dryers
- Feeders
- Idlers (belt)
- Jigs (coal washing)
- Magnetic Separators
- Pivoted Bucket Conveyors
- Pulverizers
- Scraper Conveyors
- Screens
- Spiral Conveyors
- Skip Hoists
- Sprockets
- Transmission Machinery
- V-Bucket Conveyors



Jeffrey carrying and return Idlers, equipped with Timken tapered roller bearings, are designed for belt conveyor service where efficiency, dependability and economy are desired. Available in four types.

Your inquiry will be given prompt attention. Costs lurk in unexpected places — likely our Jeffrey engineers have worked out a solution to a problem similar to yours. Write today.

THE JEFFREY MANUFACTURING COMPANY

Established 1877

932 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

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First commercial ultrasonic testing of HT-HP power piping shows value of method!

For years power engineers have known that alloy power piping might on occasion contain defects which could not be discovered by inspection methods other than radiography. But rather than adopt the virtually prohibitive expense of radiographing complete lengths of pipe, designers specified relatively high safety factors.

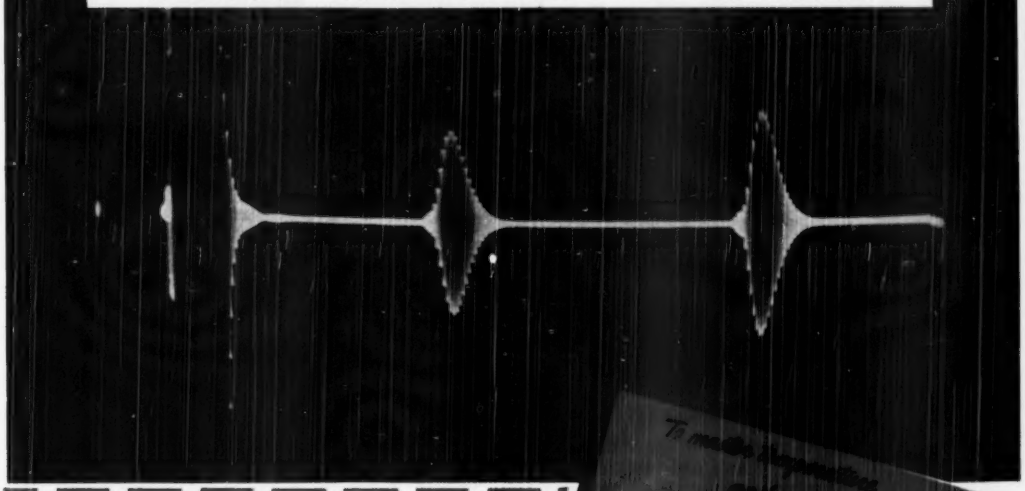
Of course this precaution did not preclude the possibility of defects, and when failures have occured, subsequent investigations have shown that internal cracks were usually the cause of the ruptures.

To meet this problem, investigations were made of inexpensive, non-destructive pipe inspection methods which could reveal hidden defects, and late in 1949, Kellogg, in cooperation with a large turbine manufacturer, presented a practical solution with the introduction of commercial ultrasonic testing of alloy piping.

Ultrasonic exploration of materials, although known for several years, has only recently been attempted on power piping. Indications now are that this technique will prove a successful and low cost means for discovering flaws and, furthermore, for putting a finger on them with startling accuracy. In view of the steadily increasing temperatures and pressures demanded by the economics of modern power generation, the value of this development is obvious.

Specific and continuing studies of this nature are among the many advantages that utility companies gain when they specify high-temperature and high-pressure piping fabricated by M. W. Kellogg.

Illustrated: *Screen pattern on the 'scope of the portable ultrasonic testing equipment currently being used by Kellogg in both shops and field.*



Special studies of unusual problems such as graphitization to assure long life and low maintenance.

Metallurgical research by recognized specialists who have made major contributions in this field.

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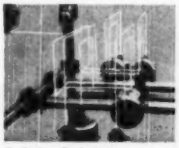

Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

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Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

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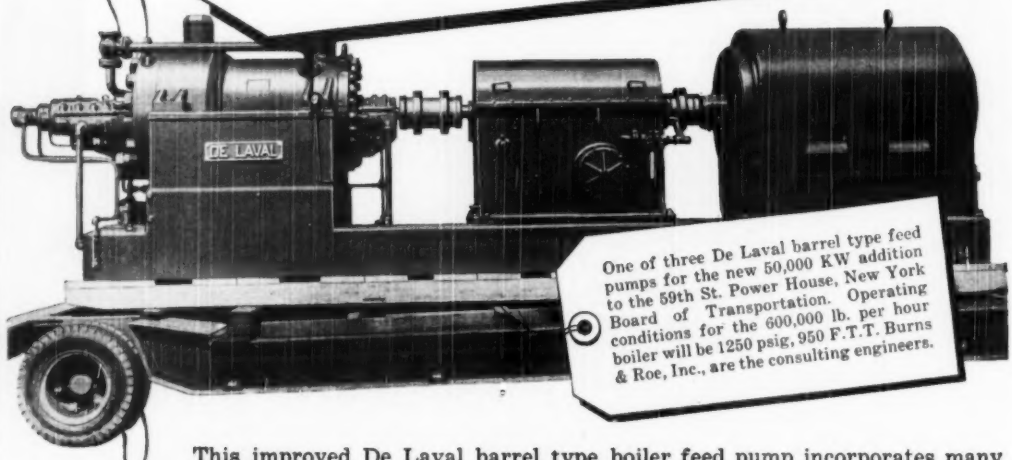
The M. W. Kellogg Company, Inc., (A subsidiary of Pullman Incorporated)—Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

The Latest De Laval Barrel Type Boiler Feed Pump

ready for shipment to

NEW YORK BOARD OF TRANSPORTATION

where it will operate at 1800 psi



One of three De Laval barrel type feed pumps for the new 50,000 KW addition to the 59th St. Power House, New York Board of Transportation. Operating conditions for the 600,000 lb. per hour boiler will be 1250 psig, 950 F.T.T. Burns & Roe, Inc., are the consulting engineers.

This improved De Laval barrel type boiler feed pump incorporates many refinements in design to meet the requirements of high pressure, high temperature, boiler feed service. For instance:

THE DE LAVAL AUTOMATIC, HYDRAULIC BALANCING DEVICE balances axial thrust so completely and automatically that no thrust remains to be taken up by bearings or other metallic contacts. The thrust bearing in the pump serves only to locate the rotor when the pump is stopped or when suction is lost.

INDIVIDUALLY BOLTED DIAPHRAGMS minimize thermal expansion strains.

THE IMO OIL PUMP employed to furnish forced feed lubrication to the bearings is direct-connected to the rotor shaft without gears.

Before specifying your next high pressure feed pumps, be sure . . . get complete information on the De Laval Barrel Pump, Catalog 15-6-P.

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

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BF-6

POWER

CROSS-INDEX OF SUBJECTS FOR THE MONTH

AUGUST 1950 • VOL 94 • NO. 8

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TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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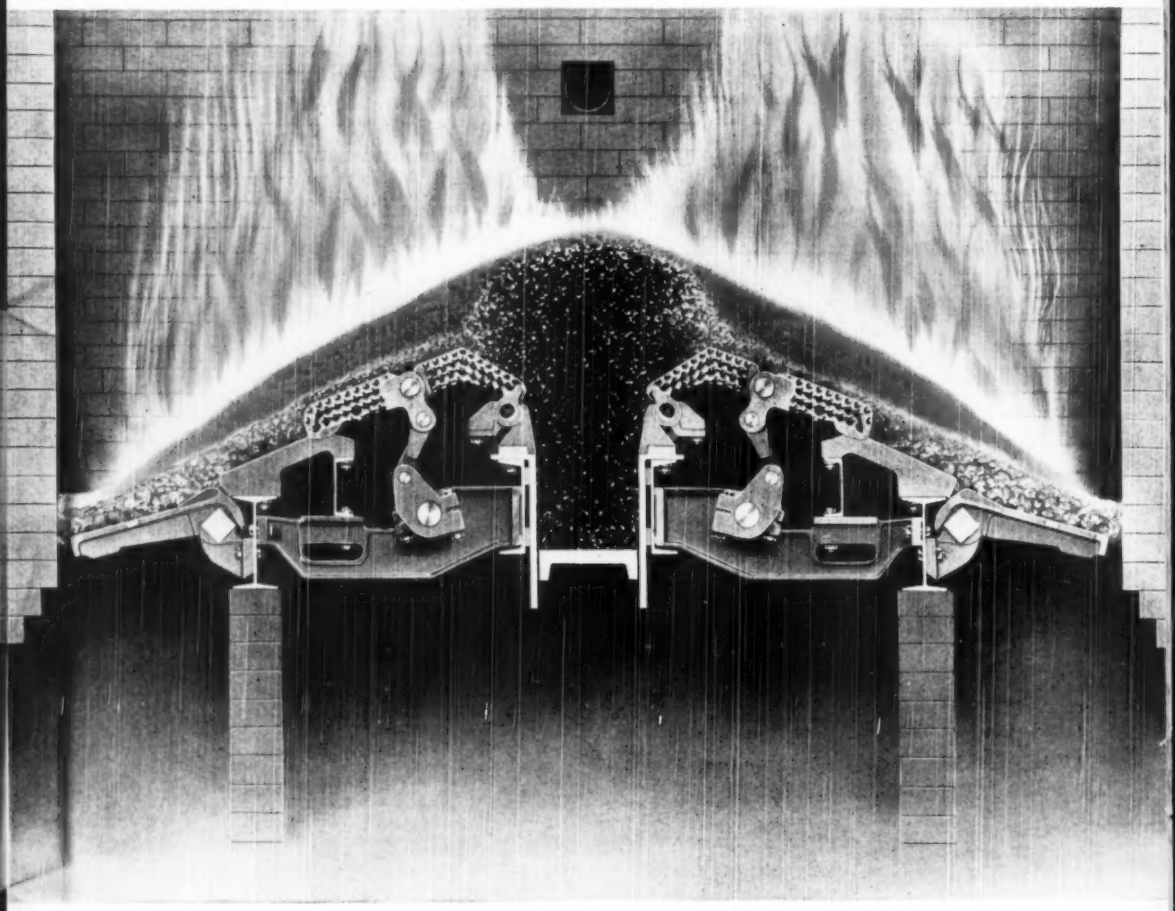
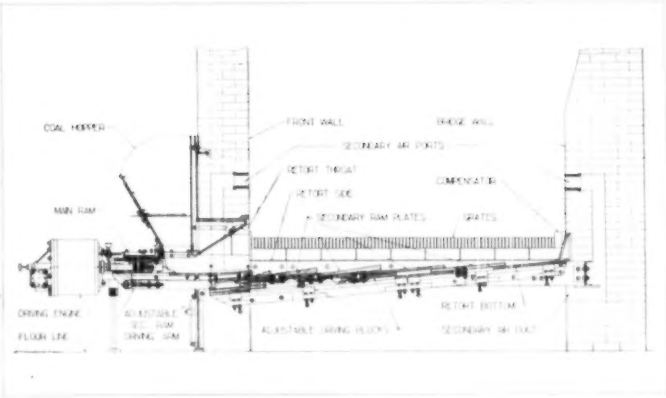
YOU CAN BE **SURE**.. IF IT'S

Westinghouse



A cross-section view of the fuel bed of the Link-Grate single-retort stoker is illustrated above. This stoker brings advantages, favorably comparable to those of the larger-capacity multiple-retort Link-Grate stoker, to the average-sized power plant (base-load capacities up to approximately 30,000 lbs. steam per hr.). It is readily installed under existing boilers with a minimum of excavation or furnace changes.



Where there's NO smoke there's a BETTER fire

The axiom, "Where there's smoke there's fire" should not apply to today's power plant.

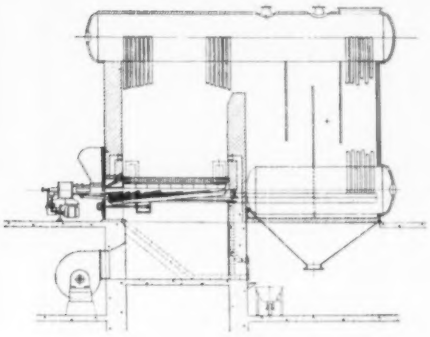
Look for the clear stack of a properly operated Link-Grate stoker-fired boiler. Combustion is thorough. No belching of smoke.

WHY—The Link-Grate's wave-like motion keeps the fuel bed porous—assures intimate mixture of fuel and air. The Link-Grate's motion maintains continuous movement of fuel bed toward the dump grates—fuel and air flow are uniform.

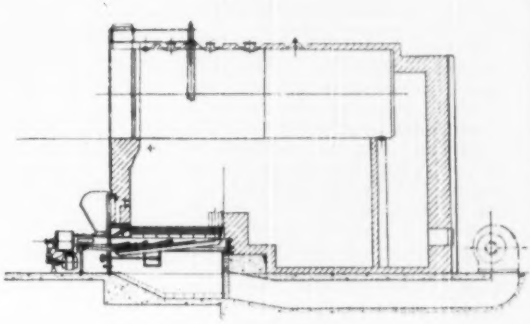
RESULT—*High Efficiency*.. by thoroughly burning the fuel on the grates with negligible waste up the stack.

Happy Neighbors.. The Link-Grate stoker-fired plant is the pride and joy of the smoke inspector.

Before you buy any stoker, be sure you know the facts about the Link-Grate. Preferably, see one in operation. Your nearest Westinghouse Office will be glad to arrange an appointment with a user. Ask or write for Booklet B-2196-A. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. I-50506



Installation for 32,000 pounds of steam per hr.



Installation for 10,000 pounds of steam per hr.

Westinghouse

Link-Grate

STOKERS

This
"Largest of its kind"
AIR CONDITIONING SYSTEM
checks corrosion with

BYERS
WROUGHT IRON
PIPE

Said to be the largest job of its kind, and one of the largest office building installations in the country, the air conditioning in this Oklahoma City building is safeguarded against corrosion by Byers Wrought Iron pipe.

Chilled water lines, recirculating water lines, and condensed water lines all utilize this time-proven material. This 1350-ton absorption-type refrigeration equipment is located in a pent-house on the 14th floor roof of one of the wings. Chilled water lines are carried on bridges across areaways. Design contemplates the use of 45° F. water.

The Southwest has been a leader in the use of air conditioning equipment, and it is interesting to note how widely engineers have forestalled corrosive attack by using Byers Wrought Iron. Since the cost of even minor repairs is bound to be high, this use of wrought iron is a definite economy measure.

Wrought iron owes its ability to combat corrosion to its unusual composition and structure. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, act like a series of baffles, to halt and disperse corrosive attack. The fibers also anchor the initial protective scale, which shields the underlying metal. In cases where galvanizing is used, the naturally rougher surface of wrought iron takes and retains a heavier coating of spelter.

With air conditioning becoming a "must" in new office building construction in many sections, you may be interested in the information contained in our bulletin WROUGHT IRON FOR REFRIGERATION AND AIR CONDITIONING INSTALLATIONS. We will be glad to send you a copy.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, San Francisco. Export Division: New York, N. Y.

First National Bank Building, *Oklahoma City, Oklahoma.*
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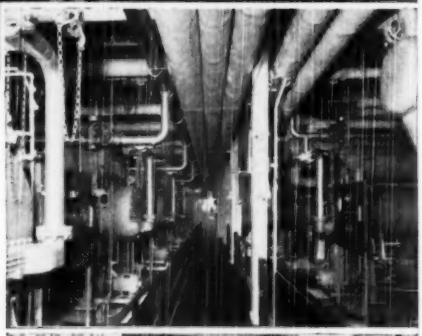
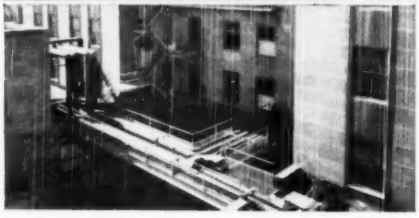
Spaeth Engineering Company, *Piping Contractors.*



Equipment room. Chilled water lines, Condensed water lines, Steam supply lines, and Steam returns exposed and under grating are all Byers Wrought Iron pipe.



Bridges carry wrought iron chilled water lines from wing to wing, solving space problems.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

POWER

PHILIP W SWAIN, EDITOR • AUGUST 1950 • ESTABLISHED IN 1882

Korea—What Does It Mean?

IT'S STILL ONLY A MATTER OF WEEKS since shooting started in Korea. In those weeks events have crowded thick and fast, leaving most of us confused and deeply concerned over what the future holds.

Is there a chance for a peaceable settlement in Korea? If not, how long a fight will it be? How much will it take to win? And most important of all, is this the beginning of World War III?

Tough questions, these. Questions for which there are no good answers. Yet for many of the decisions we'll have to make, as individuals, and as power engineers, we don't need to know the answers. The direction of events on the home front is clear and should continue whether the Korean situation is patched up next week or grows to world proportions.

Let's look at it this way: Since the first rosy glow of peace dimmed back in 1946, we've fumbled along learning the new moves and countermoves of "cold" war. At home, we've made some effort to prepare for the day when cold war might turn "hot" but actually we haven't been ready to back our plays.

At last we've had to put up and we're wondering if we've got what it takes. So we're in a much better frame of mind to face up to the realities of the world situation. Our eyes are open to the cost and we know it must be paid.

We've put our feet on the path to a war economy, whether we're legally at war or not. What happens in Korea may speed up or slow down the pace at which we follow this path. It is inconceivable that we will turn from it after this bitter warning.

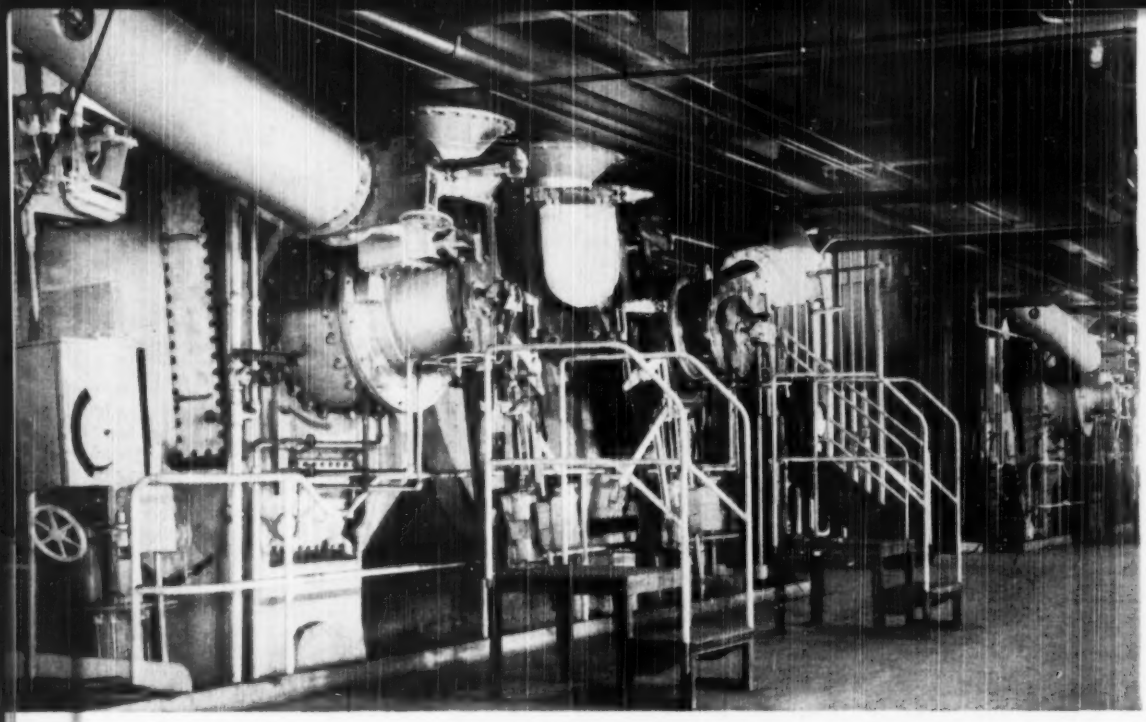
How long we'll live in this war-threatened state is anybody's guess. The only chance for an early return to a peacetime economy is a general world settlement with full and realistic guarantees—an unlikely prospect. So we'd all better figure on traveling the war-economy road for some time to come.

For most of us, the scenery will be familiar. It's only five years since we finished our last trip down it. Then we saw increased industrial production (and power loads), shortages of materials and manpower, allocations and controls.

If you don't remember the details, skim through the war-year volumes of POWER as we've just done. It'll all come back—fuel crises, conversions, dimout, brownout and blackout, interconnections and pooling, priorities, all the rest.

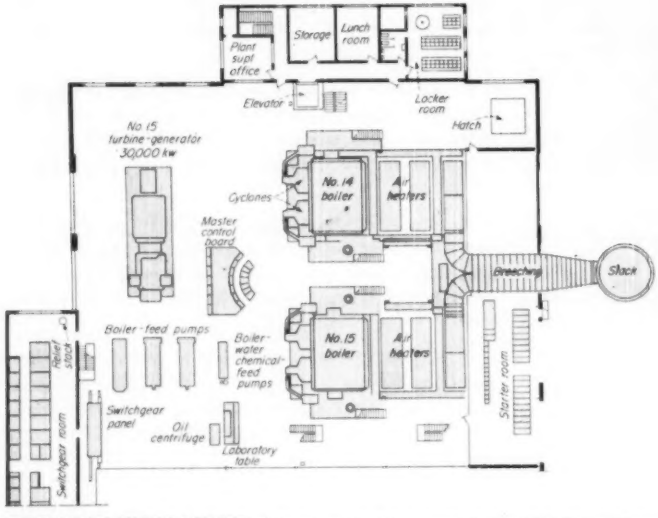
As always, POWER worked with you during those war years. We were able to give advance warning of many problems, helped you sweat them through when they came along. We're ready to do the same thing this time.

Right now, the important thing to remember is that we're heading for a war economy—like it or not, and regardless of what happens in Korea. For power engineers, this means an ever bigger job to swing, and ever less to do it with. Gear yourself, your plant and your power team for it.

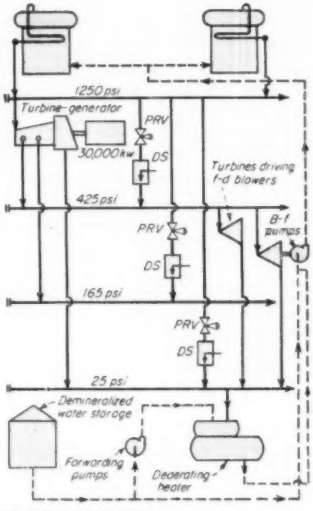


TWO CYCLONE FURNACES serve each of the two 400,000-lb-per-hr steam generators. Powerhouse bunkers store coal that is crushed, and dried as needed, in a separate preparation plant. Feeders on level above deliver coal to each cyclone furnace

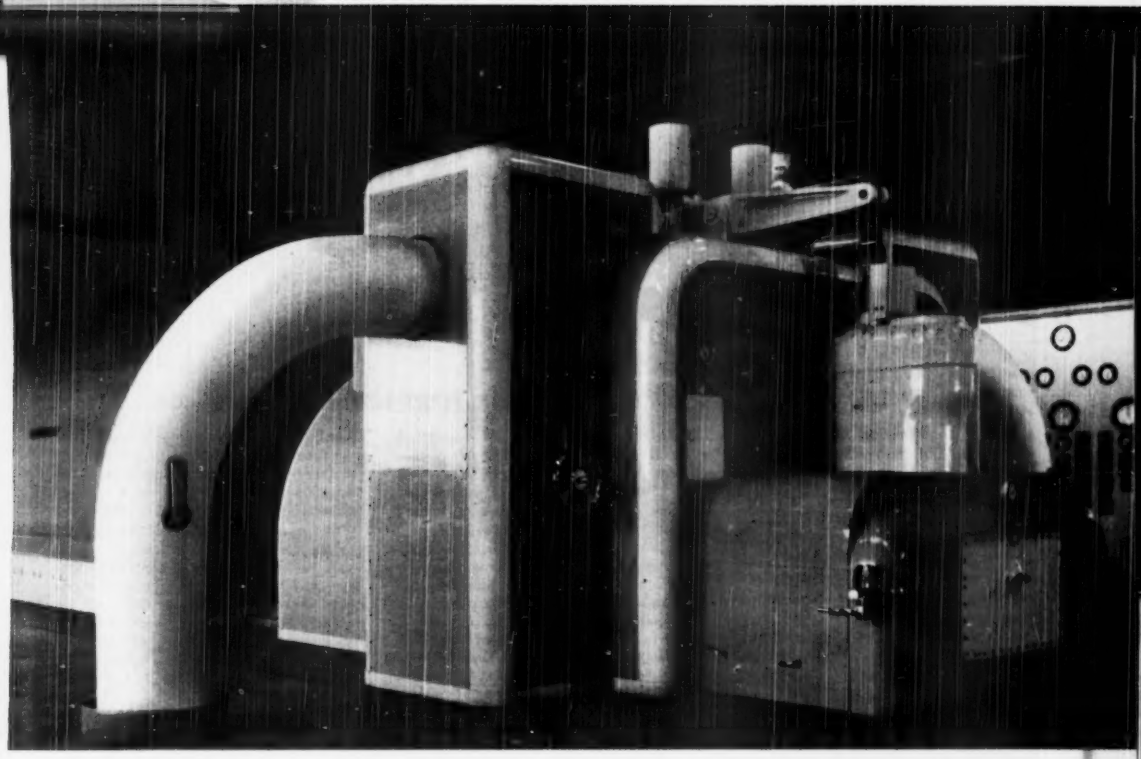
Dow's New 100% Cyclone-Fired Plant



FLOOR PLAN SHOWS LAYOUT of first unit; building space is available for another. One side of main control panel serves turbine-generator, other side serves boilers



HOOKUP DIAGRAM shows process levels, reducing stations and feedwater circuit



TURBINE-GENERATOR has two extraction points, operates noncondensing. Hydrogen-cooled 3600-rpm generator is rated at 37,500 kva with 0.5-psig hydrogen pressure, 41,250 at 10 psi and 43,125 at 15 psig. Control panel can be seen at the rear

Improves on Pioneer Installation

Reflecting experience with original unit, new 800,000-lb-per-hr 1250-psi 830-F installation features: (1) centralized coal preparation (2) different feeding arrangements (3) centrifugal blowers for pressurizing furnaces (4) improved ash disposal, and (5) unusually complete automatic control system

► PIONEERING HAS LONG BEEN a habit at Dow Chemical Co. in the power field as well as in the chemical. Back in February 1949, their engineers made news by putting the first industrial cyclone furnace on the line in the West Power House at the main plant in Midland, Mich. They've just made news again—this time with the first 100% cyclone-fired plant. It's their South Power House—just about the last word in modern industrial power.

Plant Layout. First section of this latest addition consists of two 400,000-lb-per-hr steam generators and a 30,000-kw double-extraction noncondensing turbine-generator. General arrangement is shown in floor plan on facing page. Building structure allows space for another unit.

Simplified hookup diagram shows turbine extraction at 425 and 165 psi, exhaust at 25 psi. Generator output is dependent on process-steam demand in the plant. The two extractions and the exhaust are automatically controlled from pressure. Wide-range pressure-reducing and desuperheating stations also feed the three process levels.

Feedwater. The new cyclone-fired steam generators, as well as the original cyclone unit in the West Power House, operate on 100% makeup. This comes from a recently installed demineralizing plant (POWER, Nov 1949, pp 96-101). Forwarding pumps take suction from a demineralized-water storage tank and discharge into a common deaerating heater. Two of the boiler-feed pumps are turbine driven, one motor. The other principal auxiliaries, the forced-draft blowers (more about them later), are turbine driven.

Before taking a closer look at the new equipment to see how it reflects experience with the first cyclone unit, let's get a picture of the over-all power setup and how the new plant fits into it.

Power System. To serve the many process operations in the vast Midland plant requires an electrical system that would do credit to many a small public utility. On top of that, the power department distributes steam at three pressures through miles of overhead transmission piping. In addition, four turbines, close to their loads, supply vacuum steam to evaporators. Most pressure-reducing and desuperheating

For coal handling features, turn page→

is done in the powerhouses; there are few local reducing stations.

Before South Power House went into operation, two plants and several separate units fed this system. Total capacity was 2,300,000 lb of steam and 80,000 kw. Some power was purchased from Consumers Power Co. With these facilities, steam supply proved tight. And, of course, power could be made cheaper than it could be bought because of the process-steam load. To cure this uncomfortably snug condition and make some slack, Dow engineers started design of the South Power House early in 1947. Construction began early the next year and the plant went on the line this past June. It brings total capacity to 3,100,00 lb per hr and 110,000 kw.

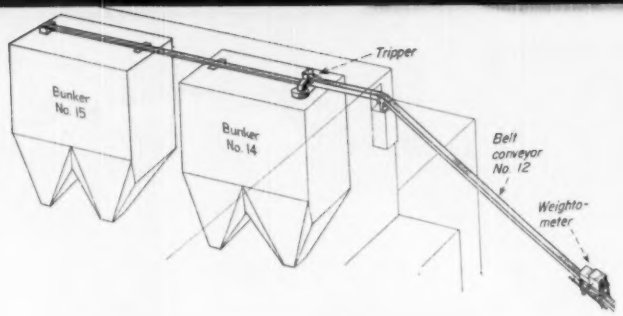
System Operation. Dow's power department plans to operate South Power House on swing load. To meet daily demands of this complex electrical and steam system, power-department dispatchers work to load schedules based on regular reports from the process departments. These estimate production and resulting loads.

Design Reasons. South Power House is coal fired, as are most units at Midland, because coal is still the cheapest fuel in that area. Coal for the conventional pulverizer-fired units originates in West Virginia for the most part, and reaches Bay City by boat. Last lap to Midland is by rail. Low-fusion coal for the cyclone furnaces comes into the plant by rail from Ohio and Illinois. Some of it is strip-mined.

Dow engineers installed the original cyclone-furnace unit because it offered good performance on low-grade coals and greatly reduced flyash emission. This latter is doubly important: (1) As the largest industry by far in Midland, Dow has a responsibility to its residents, many of whom are Dow employes. (2) Airborne dust would be harmful to some of Dow's processes and products. Experience with the first unit proved the general soundness of these reasons but indicated ways in which performance could be improved.

The following pages describe the new equipment in greater detail, emphasizing particularly the changes made for improved operation. To see how it compares with the original cyclone installation, refer back to POWER, March 1949, pp 72-75. There the first unit was described and its principle of operation explained.

Information on which this article is based was furnished by J H Meserve and A C Friel, engineers, Dow Engineering Dept, and D F Steinke, engineer, Dow Educational Dept. We acknowledge their cooperation with thanks.



CONDITIONING PLANT DRIES AND CRUSHES COAL

Coal-preparation plant is shown at right (facing page). Coal from track hoppers passes through a Bradford breaker for reduction to 1½-in. top size before going to silos for storage. From silos, coal goes to a rotary dryer, which reduces moisture to 4%. A stoker-fired-furnace supplies drying heat. Hot gases from this furnace mix with excess air, fed through the dryer by inlet and exhaust fans. An aerotec tubular dust collector in the duct to the exhaust fan removes about 80% of the dust.

From the dryer, coal goes to a vibrating screen, which separates 1/4x0-in. material for direct delivery to power-plant bunkers. Oversize coal is reduced to ¼-in. top size in a crusher and returned to the conveyor for delivery to bunkers. Conveyor to powerhouse has a weightometer.

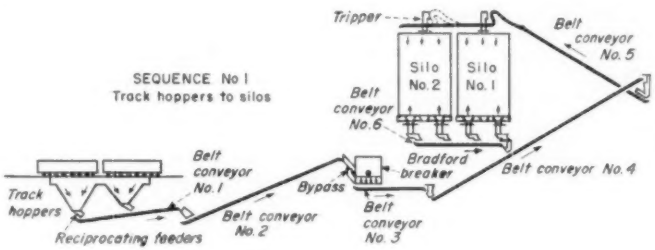
Control of feeders, conveyors and equipment for each of the two operating sequences described below centers on a main panel, which also includes controls for the dryer and its furnace. An interlock system closes down all equipment back of any unit shut down by power failure. A collecting system gathers dust at various units in the preparation plant, to be transported by induced-draft fan to a hydrostatic precipitator.

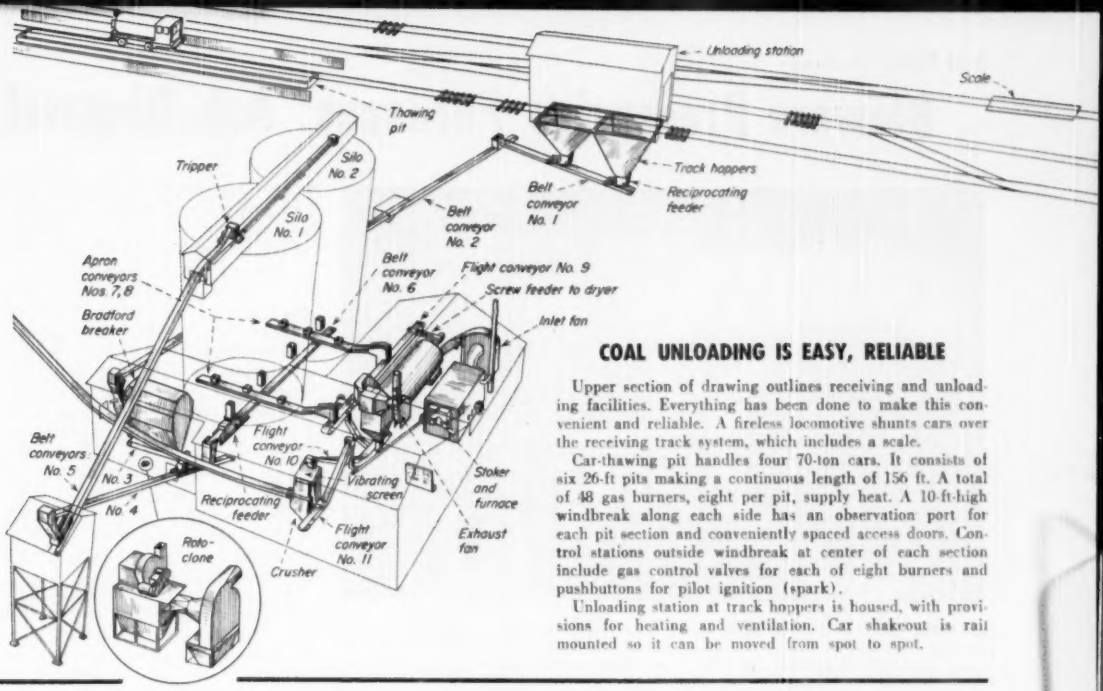
Careful Coal Conditioning

► OPERATING EXPERIENCE with original cyclone installation showed desirability of avoiding interruptions in fuel feed, such as might result from wet coal. Thus, for the new units, Dow engineers provided a separate preparation plant where coal is crushed to desired size for cyclone firing, and dried as needed. Powerhouse bunkers thus store the dry, sized coal, and feeders also work with prepared coal. Possibility of interruptions is greatly reduced. Drawing above shows equipment for unloading coal, preparing it, and delivering it to plant bunkers.

Unloading Operation. Over-all operation divides into two parts, each with its own interlocked control system. In Sequence No. 1 (see diagram below), track hoppers discharge through reciprocating feeders to belt conveyors No. 1 and 2, and thence to a Bradford breaker. This reduces coal to a top size of 1½ in. It discharges to a series of three belt conveyors (No. 3, 4, 5) which feed the two 1100-ton silos.

It is also possible to transfer coal from one silo to the other. Each has two discharge chutes. A traveling reciprocating feeder discharges coal from any one of these chutes to belt conveyor No. 6. This delivers it to conveyors No. 4 and 5, and thence back to the other silo with tripper in proper position.





COAL UNLOADING IS EASY, RELIABLE

Upper section of drawing outlines receiving and unloading facilities. Everything has been done to make this convenient and reliable. A fireless locomotive shunts cars over the receiving track system, which includes a scale.

Car-thawing pit handles four 70-ton cars. It consists of six 26-ft pits making a continuous length of 156 ft. A total of 48 gas burners, eight per pit, supply heat. A 10-ft-high windbreak along each side has an observation port for each pit section and conveniently spaced access doors. Control stations outside windbreak at center of each section include gas control valves for each of eight burners and pushbuttons for pilot ignition (spark).

Unloading station at track hoppers is housed, with provisions for heating and ventilation. Car shakeout is rail mounted so it can be moved from spot to spot.

Ensures Top Cyclone-Furnace Performance

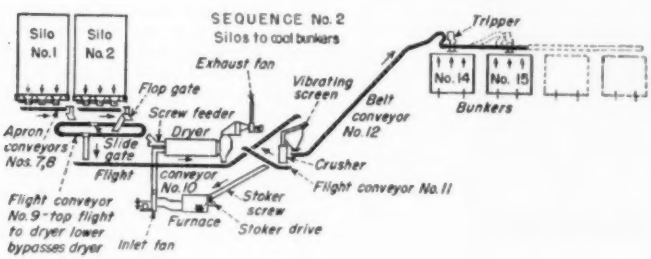
Coal Preparation. Sequence No. 2 (see diagram) carries coal from silos through preparation equipment to bunkers in powerhouse. Each silo discharges through any one or all of three gates onto an apron conveyor (No. 7 and 8). These, in turn, deliver to a flight conveyor, No. 9. Top flight discharges to a screw feeder for the rotary dryer; lower flight bypasses dryer. Coal from dryer goes to flight conveyor No. 10, which delivers to a vibrating screen. Fines (1/4x0 in.) passing through screen drop directly onto belt conveyor No. 12, go to powerhouse bunkers. Coarse coal goes through crusher and onto flight conveyor No. 11. Some coal goes to dryer-furnace stoker-feed screw; most goes back onto flight conveyor No. 10 and through vibrating screen again.

Fuel Feeding. Each boiler has its own bunker for storing crushed, dried coal. Bunker discharges in two streams each including coal scale and feeder. Each stream supplies a cyclone furnace at an approximate rate of 10 tph against a pressure of 40-50 in. H_2O.

On boiler No. 14, feeder is a flight conveyor. Flight consist of a series of cast-steel disks mounted 12 in. apart on an endless chain. Disk edges are ground to fit closely in tubular sections through which they pass. This gives sealing action against cyclone pressure. Crushed and dried coal from bunkers enters a receiving hopper through which return flights pass. Their action aids flow of coal to bottom flights, which deliver coal to discharge hopper. This has a vibrating pan which converts "slug" discharge of flights to a smooth flow for cyclone.

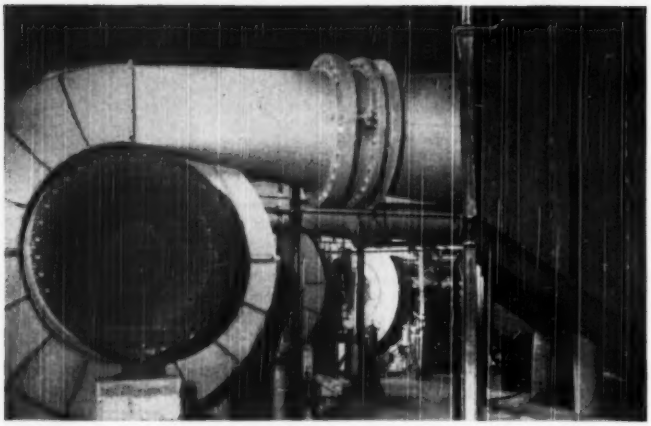
On boiler No. 15, feeder is of apron type, consisting of an endless belt of steel plates about 3 in. wide and 20 in. long. A skimmer plate at end of apron belt smoothes discharge. Siftings screw, in tapered bottom of feeder housing, operates when feeder runs; it keeps housing bottom free of coal sifting through or over sides of belt.

Coal drops from apron feeder into inlet of a star seal. This consists of a casing carrying a closely fitting cylinder with six pockets for coal. As cylinder rotates, these discharge over an angular steel plate which smoothes out flow. Blowers deliver air to space between ends of rotating cylinder and housing so there is leakage of cool air in, rather than hot air out. Cool air leakage back to feeders vents to bunkers. A safety cutout in the star seal drive protects against tramp iron.

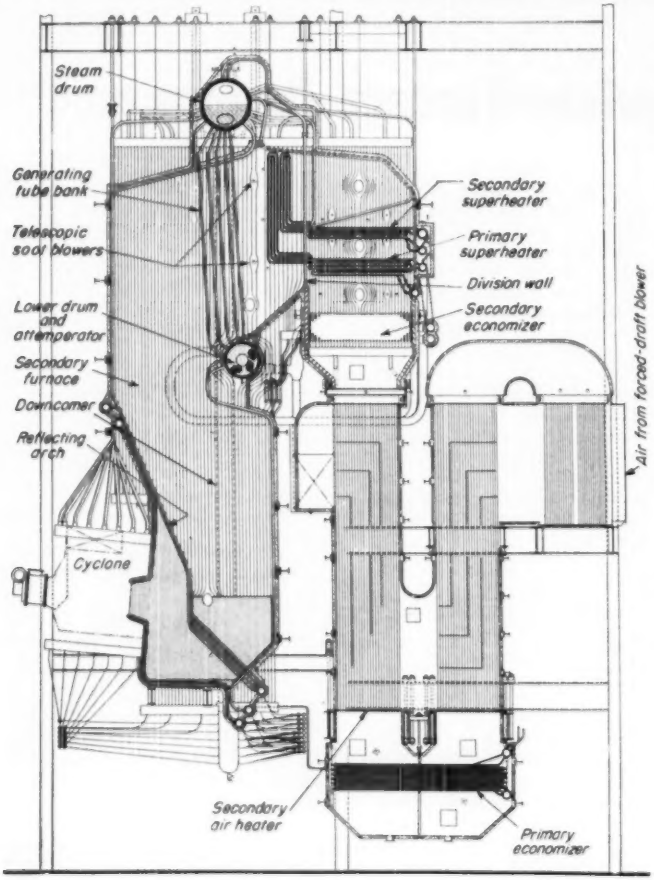


For boiler, control highlights, turn page ➤

Blowers Pressurize Furnaces; Ash Disposal



BLOWERS FOR PRESSURIZING, three per steam generator, stand right behind first air-heater section. As shown in drawing below, gas flows over two superheater sections, secondary economizer, secondary air heater, primary economizer, air heater



► TWO NEW STEAM GENERATORS differ from original installation in only a few respects. First section of air heater is behind unit rather than above. This puts forced-draft blowers on an intermediate level instead of topside. Blowers are single stage single-flow overhung-impeller centrifugals, steam-turbine driven.

Pressurizing. The new units are fully pressurized, as was the original job. There are no induced-draft fans. Blowers take air directly from blower room. This air, in turn, comes from either the boiler room, outside the plant, or both. System is so arranged that boiler-room temperature is held constant by automatic mixing of outside air and boiler-room air. Thus boiler-room takeoff is controlled for minimum heat makeup by plant unit heaters.

Air from blowers goes through three air-heater sections, then into a split duct system, around each side of boiler. On each side it passes through automatically controlled dampers. It is further subdivided into secondary, primary and tertiary air for each cyclone. Primary air enters coal stream between feeder and burner to heat coal and transport it to combustion zone. Coal and air enter furnace through automatic cantilever control dampers. Secondary air enters cyclone tangentially through automatic dampers. It provides oxygen for completing combustion and velocity for cyclone action. Tertiary air enters end of cyclone through hand-controlled damper. It imparts direction to cyclone action and supplies oxygen needed for completing combustion of fine material. These air streams are regulated by the combustion-control system.

Tempering air is controlled by manually operated blast gates, between primary-air systems of cyclone and in each duct leading to cyclones. Main air-duct dampers have hand operators for individual leaf adjustment.

Ash Removal. System for new steam generators is hydraulic. Molten slag flows out of two spouts on opposite sides of boiler. It drops into water-filled hoppers divided by Ni-Resist slide gates. Chambers above storage hoppers enclose slag spouts. There is a water-sealed expansion joint between chamber and hopper.

When lower hopper fills with slag, slide gate closes, sealing water above in upper hopper. Water below drains and feed doors open so slag can be washed to sluice trench. One oscillating nozzle and pair of upstream nozzles at each feed door completely remove all

Is Hydraulic

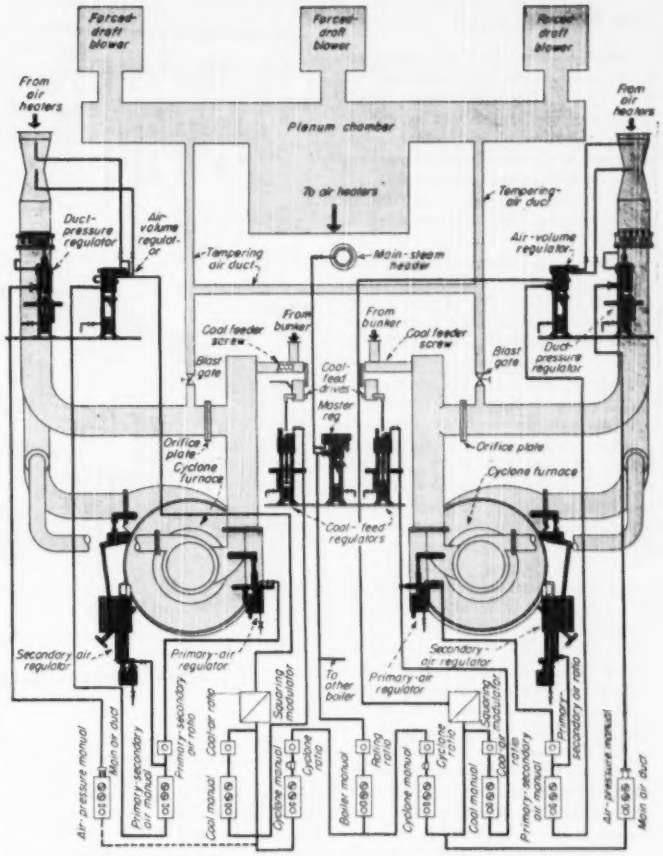
ash or slag from hopper. With slide gate closed and lower hopper being cleaned, slag continues to flow into upper hopper, which remains full of water.

On way to hopper, slag passes through a water curtain to break it into small particles. Hot furnace gas passes over the slag as it leaves the spout. This is needed to keep slag molten. Gas vents from upper hopper to lower economizer section of boiler.

Disposal to Fill. As ashes from lower hopper wash into sluice trench, they are carried along by water from transport nozzles upstream of each hopper. Ash and water from trench discharge to a sump and a grinder. Heavy cast-iron grids on each side of grinder permit fine material to pass directly into sump. Larger material is directed to grinder rolls where it is sized before going to the sump.

Pumps in a dry well adjacent to the sump discharge ashes to a fill area southeast of the plant. There are two pumps, and two fill lines. Only one is used, the other serving as standby. Sluice water is recovered and reused.

Vacuum System removes dust and siftings from lower economizer hopper and No. 1 air-heater hopper (each boiler) and from the stack base. Each opening has a hand-operated dust valve. A water-operated exhauster supplies vacuum for the system. It discharges into the sluice trench and thence to sump and fill area.



COMBUSTION-CONTROL DIAGRAM for one unit: Each cyclone is treated as separate combustion chamber. Rating relays divide load between them, also between boilers

Boiler, Turbine, PRV Control Centralized

► THIS LATEST CYCLONE-FURNACE installation features unusually complete automatic control and instrumentation. Let's look first at the main air system for each boiler. Each duct has a venturi section followed by a damper. Damper position is set automatically by an air loading sent to a duct-pressure regulator which balances this loading against measured pressure downstream of the damper.

Duct-pressure regulator also sends a loading to governor-position regulators of turbines driving blowers. Their speed changes in accordance with this loading, varying air discharge to maintain desired pressure.

Combustion Control. Automatic system diagrammed above for one boiler maintains steam pressure, air pressure and oxygen content in furnaces within preset limits. Each cyclone is treated as a separate combustion chamber.

To see how this system works, let's follow a load change and see what happens. If steam demand increases, master steam-pressure regulator, on main-steam header, reacts to increase firing rate. It sends out an air loading, which is divided between boilers by rating ratio relays. Looking now at one boiler, we see that air loading passes through cyclone ratio relays which, in turn, divide load between two cyclone furnaces serving each boiler. From here on, control is same for each cyclone.

The air loading calling for an increase in firing rate acts directly on the coal-feed regulator, through a coal-air ratio relay. We'll come back to this relay in a moment. The air loading also goes indirectly through a squaring modulator to an air-volume regulator. This regulator is also acted on by pressure drop across a venturi section of main air duct. It thus balances indicated need for air against volume actually flowing in duct. Required change in air volume is translated into an air loading to regulators for dampers in primary and secondary air ducts to the cyclone furnace. A ratio relay in this line keeps these two air flows in desired proportion.

For further control details, turn page →

DOW PLANT *Continued*

Coal-Air Ratio. Now we come back to the coal-air ratio relay mentioned before. This is electrically driven, with a declutching mechanism. An oxygen recorder measures oxygen content in furnace and sends out electrical impulses to motor drive of coal-air ratio relay.

Our initial impulse from master steam-pressure regulator has acted to step up rate of air flow and coal feed. According to measured oxygen content of the furnace, coal-air ratio relay modifies change in rate of coal feed to keep oxygen content where it should be.

Feedwater Control. A common header supplied by three feed pumps serves two boilers. Normally, the two turbine-driven pumps handle the demand, with the motor-driven unit as immediate standby. Pumps discharge into a main header through feedwater regulator valves. An auxiliary header supplies feedwater to both boilers through feedwater-regulator bypass valves. It also serves as boiler filling connection.

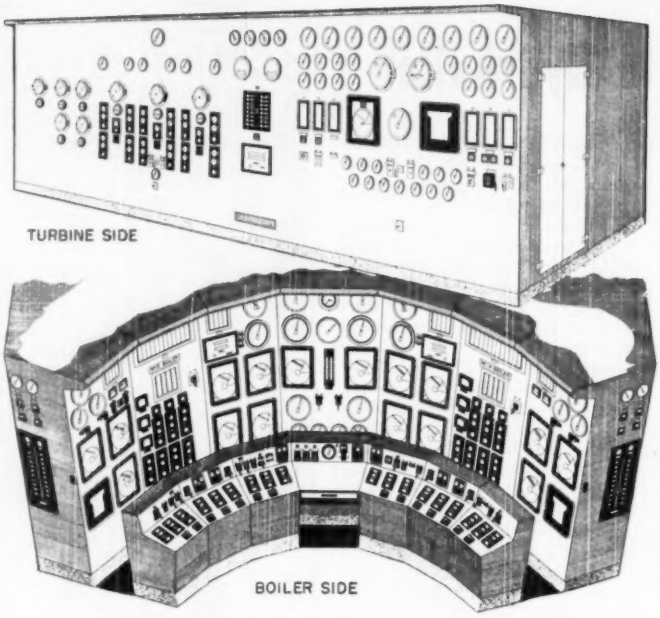
An excess-pressure control valve ahead of each feedwater regulator maintains constant differential pressure across it. Each turbine-driven pump has a governor-position regulator receiving its pressure from the common discharge of the respective pump. An air-operated valve, manually controlled from boiler panelboard, regulates discharge of motor-driven pump.

Each pump has a solenoid-operated recirculating valve on its discharge. When placed on automatic control, operation of this valve depends on water flow through a nozzle in the pump discharge downstream of the recirculating-line takeoff. With pump discharge about 150 gpm or less, recirculating valve is open. Should flow increase to about 275 gpm, recirculating valve will close and remain closed until flow again drops to 150 gpm. Recirculated water goes back to deaerator separately from each pump.

Pressure Reducing. Each of three pressure-reducing and desuperheating stations are alike in general layout and control. They are designed for a wide range of regulation. Each consists of a main reducing valve, and an atomizing-type desuperheater, with separate regulators for atomizing steam and desuperheating water. Oil-operated regulating valves are used for main steam, atomizing steam and water.

Each station has a master pressure regulator, which sends air-loading pressure through sequential relays to the main-steam and atomizing-steam regulators, and through a temperature regulator to water-control valve.

Sequence is such that all very low-range operation is handled by atomizing valve alone. This valve puts steam through atomizing orifice of desuperheater while temperature regulator controls water valve to desuperheat only small amount of steam coming through atomizing nozzle. When this is no longer enough to meet demand, sequential relays open main reducing valve. Temperature regulator then provides enough water through desuperheater, which is receiving maximum amount of atomizing steam. Thus sequential valve arrangement controls steam flow from practically zero to maximum.



MASTER CONTROL BOARD FOR BOILERS, TURBINE

Central control board (see floor plan, p 74) has a straight side facing turbine-generator and a semi-circular side, with benchboard, facing boilers. Carefully considered layout shows in perspective drawings above (made by J H Moquin, Dow staff).

Turbine Side. Instruments at right relate to turbine-generator: Pressure gages form top row, with 15 dial thermometers in two groups below. Large units in center are wattmeter, indicator and recorder for throttle flow, recorders for generator temperatures. Three rectangular units on each side are recorders for cylinder expansion, spindle vibration, governor position, speed, spindle position and eccentricity. Lower rows of dials are pressure gages.

Small group of instruments to left of turbine items are for hydrogen-cooling system: pressure gages and dial thermometers at top, signal unit and switch below. Next group to left serves three reducing and desuperheating stations. Again pressure gages and dial thermometers are at top, recorders and integrators below.

Boiler Side. At each end of cabinet are soot-blower panels. Right-hand side of vertical panel and benchboard serves No. 14 boiler; similar left-hand side serves No. 15. Some instruments common to both are in the center vertical panel.

Starting at extreme right panel, draft gage and drum-pressure gage are at top, oxygen and hydrogen recorders at right, temperature recorders at left. Next panel to left has draft gages at top. Large group of rectangular elements are speed indicators, gages and manual-automatic subpanels for forced-draft blowers and dampers.

Dials at top of next panel to left are feedwater pressure gage and drum-level indicator. Rectangular elements alongside are draft gage and annunciator. Four recorders below are for water flow, conductivity and temperatures. Center panel has pressure gage, steam-flow indicator and recorder at right side. In center and lower area are instruments common to both boilers: clock, feedwater-system level indicators and pressure gages.

Benchboards carry manual-automatic subpanels, ratio relays, position indicators, pushbuttons, switches and indicating lights for automatic combustion-control system.

PRINCIPAL POWER-PLANT EQUIPMENT

South Power House, Dow Chemical Co, Midland, Mich.

STEAM-GENERATING EQUIPMENT:

Boilers, 2 — Babcock & Wilcox Co
1250-psig 830-F radiant-type, with 1911 sq ft heating surface, 400,000 lb per hr. Two cyclone furnaces, pressurized. Continuous-tube draining-type 8100-sq-ft superheater, 2-stage interstage submerged-drum attemperator. Continuous-tube 2-section 18,700-sq-ft economizer. Tubular 134,637-sq-ft air heater

Forced-draft blowers, 3 per boiler — Ingersoll-Rand Co
214,000 lb per hr each at 105 F, 77-in.-water sp. Single-stage single-flow 3600-rpm centrifugals

Forced-draft-blower drive turbines — General Electric Co
Two multistage, one single-stage for each boiler; 425 psig at throttle, 25-psig exhaust, 750 hp each

Coal feeders, Boiler 14 — Hapman Conveyors Company, Inc
One per cyclone burner. Flight type, 10-tph capacity, each

Coal feeders, Boiler 15 — Babcock & Wilcox Co
One per burner, apron type, star-valve pressure seal. 10-tph each

Soot blowers, air puff — Diamond Power Specialty Corp

Water columns — Diamond Power Specialty Corp

Safety valves — Foster Engineering Co

Blowoff valves — Manning, Maxwell & Moore, Inc

Superheater outlet valves — Crane Co

Feedwater-inlet valves — Edward Valves, Inc

Combustion-control system, air operated — Republic Flow Meters Co

Forced-draft blower control — Republic Flow Meters Co

Superheat control — Bailey Meter Co

Coal scales — Richardson Scale Co

Coal valves — Stock Equipment Co

Ash-removal system, hydraulic — Allen-Sherman-Hoff Co

TURBINE-GENERATOR:

Turbine-generator, one — Westinghouse Electric Corp
1250-psig 830-F throttle steam, 425- and 165-psig extraction, 25-psig exhaust. 30,000-kw 0.8-pf 13,800-v 3-phase 60-cycle 3600-rpm generator hydrogen cooled. 150-kw direct-connected main exciter, 2.5-kw direct-connected pilot exciter. 6140-sq-ft 2-pass hydrogen cooler, 455-sq-ft 8-pass exciter air cooler

Exciter air filter, 3-section — American Air Filter Co, Inc

Oil coolers, two, 500 sq ft each — Westinghouse Electric Corp

FEEDWATER EQUIPMENT:

Boiler-feed pumps, 3 — DeLaval Steam Turbine Co
6-stage single-suction volute-type solid-case 1200-gpm 3570-rpm centrifugals rated at 1554-psi net pressure. Two driven by 7-stage steam turbines, 425-psig throttle pressure, 25-psig exhaust, 1470 hp. One driven by 1500-hp 2300-v 3-phase 60-cycle motor

Turbine-driven feed-pump control — Republic Flow Meters Co

Motor-driven feed-pump discharge valve — Republic Flow Meters Co

Feed-pump recirculating valves — Republic Flow Meters Co

Deaerating heater, atomizing type — Cochrane Corp
950,000 lb per hr, 267 F, 25-psig steam. Two 150-sq-ft vent condensers. 25,000-gal storage tank

Heater water-level control valve — Fisher Governor Corp

Heater relief valve, multiport — Cochrane Corp

Feedwater regulator — Northern Equipment Co

Excess-pressure regulator — Republic Flow Meters Co

Continuous-blowdown exchanger, flash tank — Cochrane Corp

Heater level indicator — Reliance Gauge Column Co

COAL-HANDLING AND PREPARATION EQUIPMENT:

Locomotive, 50 tons, fireless — H K Porter Co, Inc

Gas burners in car-thawing pits — Maxon Premix Burner Co

Coal-car shakeout — Robbins & Myers, Inc

Conveyors and feeders — Link-Belt Co
200 tph from track hopper to silos, 80 tph silos to bunkers

Breakers and crusher — Pennsylvania Crusher Co

Dryer and screens — Link-Belt Co

Dryer dust collector — Aerotec Co

Dryer furnace, 70,000 cfm at 700 F — Furnace Economy Co

Spreader stoker for dryer furnace — American Engineering Co

Dryer inlet and exhaust fans — Clarage Fan Co
Inlet: 70,000 cfm, 700 F, 6-in. sp, 150-hp motor.
Exhaust: 45,350 cfm, 210 F, 5-in. sp, 75-hp motor

Dryer-furnace control — Brown Instrument Co

Conveyor dust collector — American Air Filter Co

Weightometer — Merrick Scale Mfg. Co

Coal silos, two 36-ft dia, 60 ft high — Neff & Fry Co

Ventilators — Swartwout Co

PIPING, VALVES AND INSULATION:

High-pressure piping — M W Kellogg Co

Reducing valves and desuperheaters — Republic Flow Meters Co

Gate and globe valves — Crane Co

Small h-p valves — Crane; Edward; Manning, Maxwell & Moore

Service-water control valves — Fisher Governor Co

Safety valves — Farris Engineering Co

Relief valves — Atwood & Morrill Co

Miscellaneous valves — Crane Co; Lunkenheimer Co

Air reducing valves — Leslie Co

High-temperature pipe insulation — Union Asbestos & Rubber Co

Low-temperature pipe insulation — Johns Manville

Steam traps — Strong, Carlisle & Hammond Co

METERS AND INSTRUMENTS:

Draft gages — Hays Corp

Flowmeters — Bailey Meter Co; Foxboro Co; Republic Flow Meters Co

Indicating-pressure gages — Manning, Maxwell & Moore, Inc

Pressure recorders — Bailey Meter Co

Indicating thermometers — Manning, Maxwell & Moore, Inc; Taylor Instrument Cos

Temperature recorders — Bailey Meter Co; Leeds & Northrup Co

Hydrogen Recorders — Cambridge Instrument Co.

Liquid-level recorder — Foxboro Co

Conductivity, oxygen, pH, water-level recorders — Bailey Meter Co

Annunciators — Edwards & Co

Speed indicators — General Electric Co; Metron Instrument Co

Ammeters — Weston Electrical Instrument Corp

Wattmeter — Leeds & Northrup Co

Level switches — Fuller Co; Bender Warwick Controller Co

Instrument panels — Falstrom Co

ELECTRICAL EQUIPMENT:

13.8-kv switchgear — General Electric Co
15-kv cubicle, 2000-amp, 1,500,000-kva, air operated. Two main sections, synchronizing bus and transfer bus. One generator circuit, 37,500 kva; 6 feeder circuits, 1200 amp; one transformer circuit for two 5000/6667-kva 3-phase banks; one synchronizing bus-tie circuit, 2000 amp; one transfer bus-tie circuit, 2000 amp

Switchgear air compressors, 3 — General Electric Co
350 psig, 9 cfm with 17 of storage receivers; 3 extra receivers

Synchronizing reactors — General Electric Co
Three 13.8-kv 2000-amp single-phase, 6%

Generator circuit breakers — General Electric Co
Neutral breaker: 15-kv metal-clad, 1200 amp, 500,000 kva. Neutral grounding resistor: 8000-v 2000-amp 4.0-ohm, one minute, metal enclosed. Field breaker: metal-enclosed, drawout air circuit breaker, 250-v dc, 800 amp

Generator voltage regulator — General Electric Co
One indirect-acting with auxiliary motor-driven exciter rheostat

Generator surge-protective equipment — General Electric Co
One metal-enclosed equipment containing 3 station-type lightning arresters and 3 capacitors

Generator bus — General Electric Co
2000-amp 3-phase 15-kv metal-enclosed bus about 90 ft long

Station switchboard — General Electric Co
8-section duplex control switchboard with two swinging brackets

Station-service switchgear, 2300 v — General Electric Co
5-kv metal-clad with 1200-amp 150,000-kva breakers. Two sections, 9 units each section, tie between sections

Station power switchgear, 440 v — Westinghouse Electric Corp

Station-service transformers, 13.8/2.3 kv — General Electric Co
Two 5000/6667-kva self or forced-air cooled, 3-phase, delta-delta

Station-power transformers, 2300/440 v — Westinghouse Electric Corp
One 1000 and one 750-kva, air-cooled, 3-phase, delta-delta

Station battery — Electric Storage Battery Co
One 60-cell 125-v pasted-plate type sealed in glass jar. 320 amp for one minute down to 1.75 v per cell

Battery-charging equipment — General Electric Co
Cubicle with phanotron charger: 125 v, 12.5 amp, 115/230 v, ac

Power cables, 3-conductor, 15-kv — General Electric Co,
VC, Flamenol jacket, bronze interlocked armor, aerial type

Motors — Elliott Co, General Electric Co,
Reliance Electric & Engrg Co, Westinghouse Electric Corp

MISCELLANEOUS EQUIPMENT:

Sluice-water pumps, 2 — Worthington Pump & Machinery Corp
2200-gpm, 265-ft discharge head, 4-stage, vertical turbine-type 200-hp 1800-rpm 2300-v 3-phase 60-cycle motors

Forwarding pumps, 2 — Ingersoll-Rand Co
2000-gpm 230-ft total head, single-stage double-suction centrifugal volute. 150-hp 1750-rpm 2300-v 3-phase 60-cycle motor

Cooling-water pumps, 2 — American-Marsh Pumps Inc
1000 gpm, 100-ft head, single-stage double-suction centrifugal. 40-hp 1750-rpm 440-v 3-phase 60-cycle motor

Cooling-water return pumps, 2 — American-Marsh Pumps, Inc
750-gpm 80-ft head, single-stage double-suction centrifugal. 20-hp 1750-rpm 440-v 3-phase 60-cycle motor

Locomotive water pump — Ingersoll-Rand Co
20-gpm 225-psig discharge head, 4-stage single-suction opposed impeller centrifugal. 10-hp 3450-rpm 440-v 3-ph 60-cyc motor

Chemical feed pumps, 3 — Milton Roy Co

Sump pumps — Weil Pump Co

Condensation-return unit — American-Marsh Pumps, Inc

Soot-blower air compressor — Ingersoll-Rand Co
790 cfm 500-psig discharge 3-stage reciprocating. 300-hp 360-rpm 2300-v 3-phase 60-cycle synchronous motor

Plant air compressor — Fuller Co
1590-cfm 100-psig discharge 2-stage rotary. 350-hp 575-rpm 2300-v 3-phase 60-cycle motor

Intake filter, soot-blower compressor — American Air Filter Co

Aftercooler, plant compressor — Pennsylvania Pump & Compressor Co

Air receivers — Edgemoor Iron Works

Water tank, 40-ft dia, 70 ft high — Chicago Bridge & Iron Co

Dust hopper and breeching — Connery Construction Co

Masonry stack — Alphons Custodis Chimney Construction Co

Coal bunkers — Fort Pitt Iron Works

Turbine-room crane, 75-ton — Whiting Corp

Receiving-room crane, 5-ton — Robbins & Myers, Inc

Compressor-room hoist, 6-ton — Yale & Towne Mfg Co

Blower-room crane, 10-ton — Whiting Corp

Blower-room hoist, 10-ton — Yale & Towne Mfg Co

Dust collector, coal bunkers — American Air Filter Co

Combustion-air-intake-filters operator — Johnson Service Co

Combustion-air heaters — Trane Co

Oil purifiers — DeLaval Separator Co

Instrument-air dehydrator — Davison Chemical Co

BUILDING:

Design engineers — Dow Chemical Co

General contractor — Austin Co

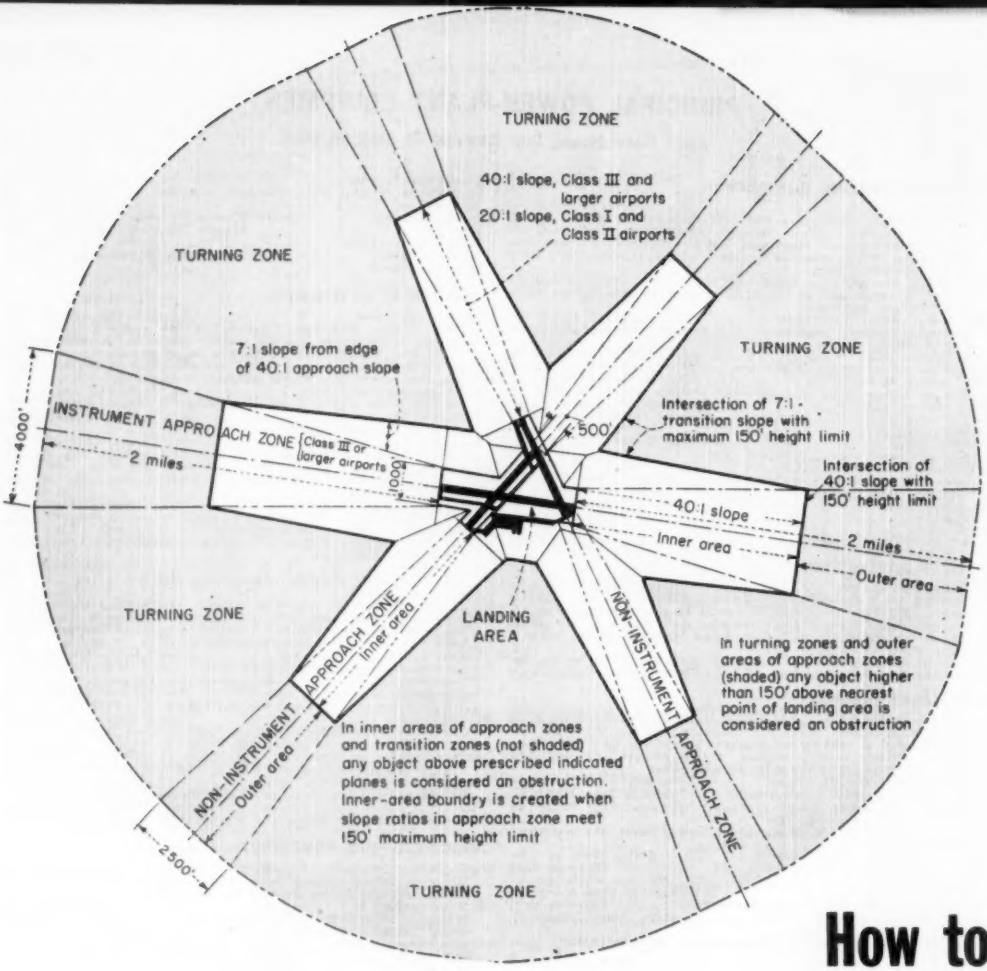
Building piling — Raymond Concrete Pile Co

Elevator — Detroit Elevator Co

Steel sash — Truscon Steel Co

Heaters — Trane Co; L J Wing Mfg Co

Temperature controllers — Fulton Sylphon Co; Johnson Service Co


TURNING ZONE
40:1 slope, Class III and larger airports
20:1 slope, Class I and Class II airports
TURNING ZONE
7:1 slope from edge of 40:1 approach slope
TURNING ZONE
INSTRUMENT APPROACH ZONE
Class III or larger airports
4000'
2 miles
1000'
500'
Intersection of 7:1 transition slope with maximum 150' height limit
Intersection of 40:1 slope with 150' height limit
40:1 slope
Inner area
2 miles
Outer area
TURNING ZONE
LANDING AREA
APPROACH ZONE
Inner area
NON-INSTRUMENT
NON-INSTRUMENT
APPROACH ZONE
Outer area
2500'
In turning zones and outer areas of approach zones (shaded) any object higher than 150' above nearest point of landing area is considered an obstruction
In inner areas of approach zones and transition zones (not shaded) any object above prescribed indicated planes is considered an obstruction. Inner-area boundry is created when slope ratios in approach zone meet 150' maximum height limit
TURNING ZONE

How to

Airport Approach Standards; What They Mean to You

By V T GUCCIONE

Aids and Hazards Specialist, Civil Aeronautics Administration—Region 1

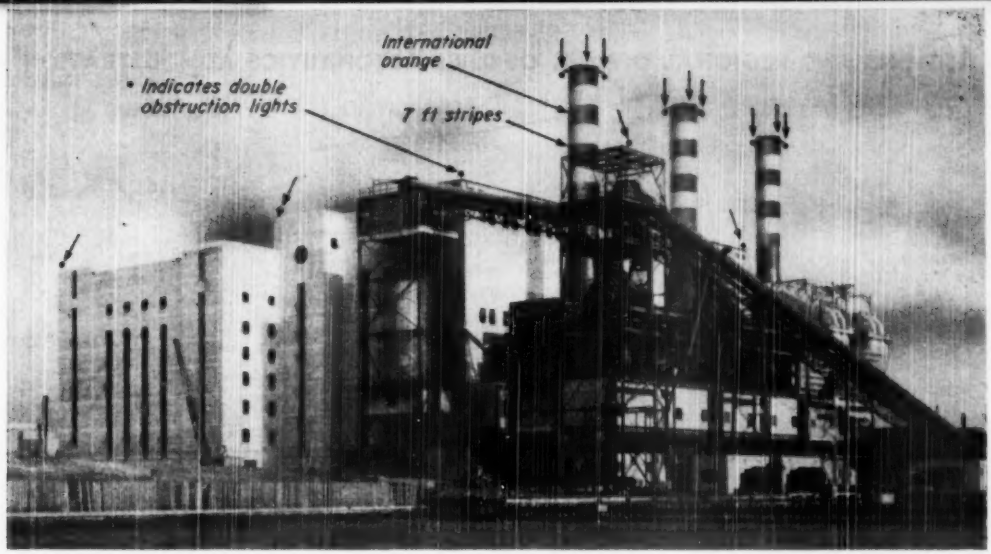
► COMMERCIAL AIRCRAFT FLIGHTS are usually cleared to follow civil airways that may be likened to highways in the sky. Along them the Civil Aeronautics Administration maintains and operates visual and electronic aids for air navigation. It also guards them, and the areas around airports, against hazards to safe flight. Your power plant may be such a hazard. How can you tell, and what should you do about it? Here are some answers:

Areas Involved. When air traffic between two points requires safeguarding in the opinion of CAA, the route is designated as a civil airway. These air "roads" are ten miles wide. The strip to be protected against potential hazards extends for 20 miles on each side. So a zone 50 miles wide is covered by Federal regulations. In addition, areas about airports are protected (see diagram on this page).

Plan above shows area surrounding an airport within which structures may be obstructions. Dimensions depend on airport size. Runway length forms basis for classification, as follows: Class I, Secondary, 2301 to 3000 ft; Class II, Feeder, 3001 to 3500 ft; Class III, Trunk Line, 3501 to 4200 ft; Class IV, Express, 4201 to 5000 ft.

In diagram, *landing strips* show as solid black and outline of *landing area* is heavy. *Approach zones* start at runway ends. Ground width of such zones varies slightly with type of airport but may be taken as 500 ft at end of a non-instrument runway, flaring out uniformly to 2500 ft at a distance of two miles. This shows in dash-dot lines on diagram. In profile, approach zone starts at ground elevation at runway end and rises uniformly to a maximum height of 150 ft. Slope is 20:1 for Class I and II airports, 40:1 for Class III and larger. Area in which these slopes prevail is *inner area* of approach zone. At either side of the zone in the inner area are *transition zones*. In these, height is fixed by a 7:1 slope upwards to the maximum height of 150 ft. Outlines of these transition zones are shown in solid line. Area between approach and transition zones, out to a 2-mile radius from runway ends, is the *turning zone*. While less critical than approach zones, any structure in a turning zone more than 150 ft high may be deemed an obstruction. Normally, turning zones need special study.

Same general rules apply for instrument runways. Approach zone is 1000 ft wide at runway end, flaring out to 4000 ft at a distance of 2 miles. Approach-zone slopes for instrument runways are 50:1.



OBSTRUCTION MARKING: On this power-plant photo, typical day and night hazard marking has been indicated. Note recommended orange and white striped painting of stacks; location of double obstruction lights to mark stacks, building outline

▶ On the surface, generating and distributing power seems totally unrelated to safe conduct of air-line operations. Yet your plant and transmission towers can be obstruction hazards

▶ So Federal laws safeguarding civil air commerce apply to existing and proposed plants and distribution systems within 50-mile strips along civil airways and in areas adjacent to airports

▶ With air traffic ever increasing, more and more designers and operators need to know about these rules. Here's practical information on construction, painting and lighting of such structures

Check Your Plant for Aircraft Hazards

With the ever growing number of these air roads and terminals, rare indeed is the town or city east of the Mississippi that does not come within CAA's jurisdiction in respect to construction or alteration of structures such as power plants and transmission towers.

Steps to Take. Federal statute assigns to the Administrator of Civil Aeronautics the authority to require notification of construction or alteration of structures along or near civil airways and near airports. Regulations of the Administrator (Part 625*) say that such notice shall be given when:

(1) the structure extends more than 150 ft above ground and is along or within 20 miles of a civil airway.

(2) the structure is within 15,000 ft of the nearest boundary of an aircraft landing area, if top of structure is higher than 5 ft above ground for each 500 ft of its distance from the boundary of a landing area. (Landing areas are listed in *"Civil Aeronautics Flight Information Manual"*.)

If you're proposing to build or alter a plant that falls within this definition, notice should be given to CAA at least 30 days but not more than 60 days before start of work. Submit notice in triplicate, using Form ACA 117*, "Notice of Construction or Alteration of Structures."

Start Early. Actually, you should check into this matter much earlier—when preliminary surveys are made for the new plant or transmission line. It is also a good idea to consult the building department having jurisdiction over the proposed site. This will show if any state or municipal ordinances also apply to erection of high structures in approaches or turning areas of nearby airports.

CAA representatives in each region (see map, next page) are eager to assist in checking your proposed location as an aircraft hazard. They won't treat your problem arbitrarily. They will offer valuable assistance in working out a satisfactory answer—one that will be least objectionable from an aeronautical standpoint yet will meet your requirements. Sometimes moving a structure site by as little as 1000 ft makes the difference between a menace to air traffic and a structure that will not be unduly dangerous when properly marked.

CAA Studies. Ground studies are usually made by aviation safety agents or airport engineers assigned to the district. Whenever needed, flight checks

*Part 625 of Regulations and Form ACA 117, "Notice of Construction" may be obtained without cost from regional CAA office in your area.

**This manual may be obtained, at $1.00 per copy, from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

REGIONS AND REGIONAL OFFICES OF CIVIL AERONAUTICS ADMINISTRATION

Civil Aeronautics Administration

Federal Building
New York International Airport
Jamaica, N. Y.

84 Marietta Street, NW
Atlanta 3, Ga.

Chicago-International Airport
Park Ridge, Ill.

PO Box 1689
Fort Worth, Texas

9th Floor, City Hall Building
Kansas City 6, Mo.

5651 W Manchester Ave
Los Angeles 45, Calif.

PO Box 3224
Seattle 14, Wash.

of proposed sites will be made. Thus you will have assurance that your proposed structure won't present excessive air hazards and that you have safeguarded your company's installation as far as possible.

If, after study, CAA engineers find the proposed structure presents hazards, they will provide recommendations for suitable obstruction marking and hazard lighting. Here again, these will not be arbitrary. They will be based on careful study of your problem. Marking recommended will be only that needed to safeguard lives and property, both airborne and on the ground. From a public relations point of view, it is clearly to the advantage of a public utility or an industrial company to be able to state that all possible action has been taken to preclude aircraft accidents.

Day Marking. To warn airmen of the presence of a structure that presents a hazard, it is marked or painted to make it more visible during daylight hours. No general standards can be given for day marking, however. A structure may be naturally conspicuous by contrast of color or construction. It may be located with reference to other structures or the ground contour in such a way that marking need be applied only to upper portions.

Photo on preceding page shows a typical marking design for stacks. High-tension towers are treated in much the same way. Colors should be international orange and white. These are recommended national standards to denote hazards to air traffic.

Hazard marking need not be applied on lower one third of a structure more than three miles from a landing area if unpainted portion does not exceed a height of 100 ft above ground. All structures should be cleaned or repainted as often as needed to maintain good visibility.

As an alternate to painting, glazed brick of white and orange colors are sometimes used as face brick for the structure. This eliminates much of the maintenance problem. M W Kellogg Co will use this type of marking at the Meadowbrook, L. I. hospital project.

Night Marking. During hours of darkness or poor visibility, hazard lighting serves to make airmen aware of a structure that presents some degree of hazard. Such lighting, whether of stacks or transmission towers, should be discussed with a CAA representative. He will see that design and installation of lights will make the obstruction readily visible from aircraft at any angle of approach.

Lighting on a structure where there is normally no attendant should be controlled by a light-sensitive device. This should be adjusted to turn on lights when north-sky light-intensity drops to about 35 foot-candles and to turn off at about 58 foot-candles.

No Fixed Rule. CAA provides suggestions for marking and lighting, based on heights above ground and location on airways or proximity to airports. Remember, however, that these should be considered only as general until finally evaluated by an actual study of your site and proposed structure. For example, a structure of a particular height may be so situated as to present an unusual hazard and thus call for marking applicable to a higher structure. On the other hand, a high structure close to an airport may need no marking if it is shielded by existing marked obstructions.

This means that studies made by CAA to evaluate a potential hazard must necessarily be individual for each proposed structure. For airways, such studies will take account of traffic and minimum en-route instrument altitudes. For airport areas, they will consider landing procedures, glide ratios, etc. For details of airport approaches, see diagram on p 82.

Five Steps. The following procedure is a good one to follow if you expect to build a new plant or transmission line:

(1) Determine which CAA regional office has jurisdiction over proposed site (see map above).

(2) Obtain informal approval from CAA and municipal authorities for construction at height proposed and location specified, before making final commitments for land, etc.

(3) Obtain hazard painting and lighting recommendations from CAA for inclusion in construction specifications.

(4) Submit formal notice of construction to CAA as per regulations.

(5) Advise CAA when construction is complete and recommended hazard marking has been provided.

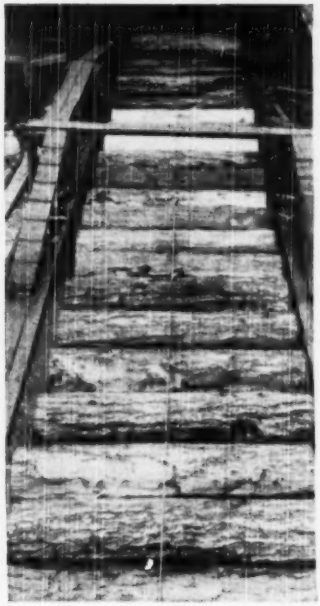
Existing Structures. When air activity in your locality increases, the question of hazard marking may arise. From the standpoint of safety and good public relations, it would then be wise to request a study of the problem. Your local CAA representative will be glad to make an investigation and offer recommendations.

When in Doubt. Remember CAA is a Federal agency charged with providing a public service. When in doubt, contact your regional CAA office and let them help you. You will find the Administrator cooperative. He will assign staff personnel to review your case and furnish you with whatever assistance may be needed.

STANDING TIMBER . . .

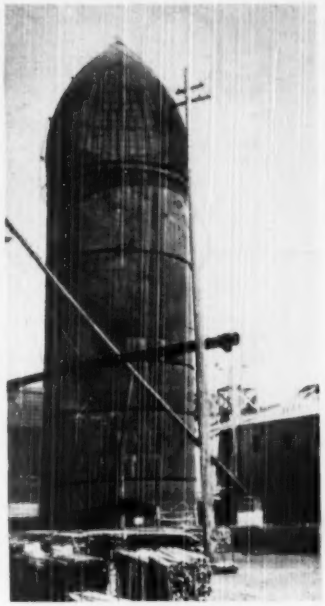
1 Forest-products industries recognize value of constant new timber supply

CUT FOR HANDLING



2 Large-scale production employs many conveyors, and heavy mechanization

REFUSE WAS WASTED



3 Hogged fuel, spent chips were burned in incinerators but practice is fading

Burns Wood Waste by Spreader Stoker

No longer are hogged fuel, bark trimmings, spent chips a waste in forest industries—they're valuable fuel. The spreader stoker puts them to work with increased boiler output, reduced grate upkeep, quicker load response

By **N SPRINGATE**, *Assistant Supt, Canadian Forest Prod Ltd, New Westminster, B. C.*
H G MEISSNER, *Stoker Engineering Dept, Combustion Engineering-Superheater, Inc*

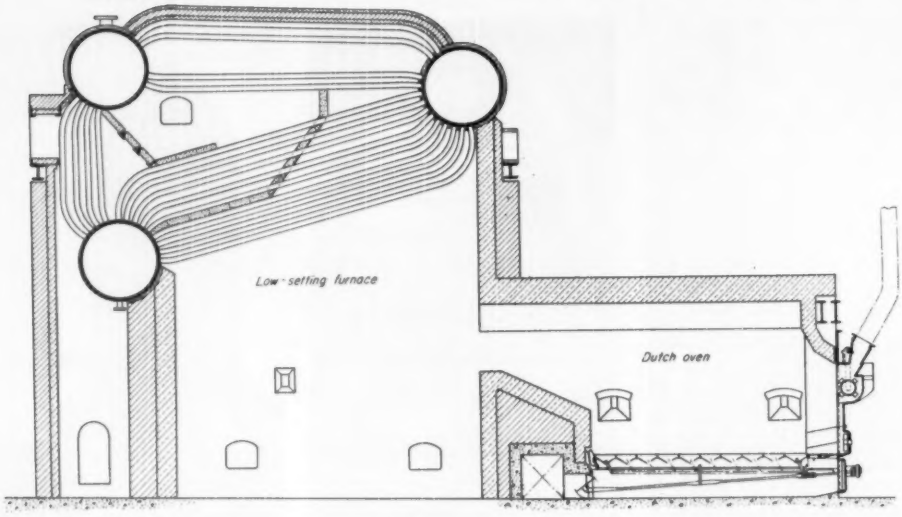
► CHANGES IN industrial conditions often lead to revisions in manufacturing and production processes. When that happens the equipment manufacturer has to develop new or improved products to meet the new requirements. Just such a situation has been developing in the forest-products industries for the past several years, especially where spent chips, hogged wood, bark trimmings and other cellulose byproducts are used as boiler fuel. One indication of this trend is the fact that the title "refuse fuel" is rapidly superseding the term "wood waste."

In many plants this refuse is no longer a surplus material to be disposed of largely by incineration, Fig. 3. It has become a fuel of definite market value so its efficient combustion is desirable.

In July 1949, Pacific Veneer and Plywood Division of Canadian Forest Products, Ltd., New Westminster, B. C., put in a spreader-stoker-fired hogged-fuel furnace to obtain the best possible combustion efficiency from their refuse fuel. Behind this installation stand some five years of experiment and study.

Firing Development. Along about 1943 a large Eastern naval stores plant found their production of spent chips, formerly in excess supply, was no longer enough to meet fuel requirements. They had to use considerable fuel oil to make up the difference. So Combustion Engineering-Superheater, Inc, was called in to cooperate in developing a more efficient firing method for spent chips. A modified spreader stoker and traveling-grate furnace gave such satisfactory results that CE went ahead with additional installations not only in forest-products industries, but sugar mills, too, where they found that bagasse burned equally well in this type furnace.

SPREADER STOKERS CAN BE PUT INTO OLDER, LOW-SETTING FURNACE DESIGNS . . .



4 Canadian Forest Products, Ltd had to buy hogged fuel when it installed new hardboard mill. So they now get the most out of all refuse fuels with spreader-stoker firing. First unit, an old low-setting furnace, had stoker in the dutch oven

The underfeed and chain-grate stokers, however, had not been forgotten. They underwent extensive tests with this class of fuel, but results proved them less satisfactory than the spreader.

All tests and operating experiences indicated that locating the spreader-stoker distributor about three feet above the grate gave: (1) satisfactory operation (2) easy installation for most units.

Combustion air and its delivery came in for considerable attention. It was admitted to the furnace from several locations, both above and through the fuel bed. When air was supplied principally through the grates, with just enough overfire air or steam jets for good turbulence, it could be controlled most simply, either manually or automatically. A thin, level fuel bed, evenly distributed on the flat-grate surface, assured a uniform air flow.

Next came the problem of controlling fuel-air ratio. This one factor had long been a major cause for low combustion efficiency in commercial cellulose-fuel-burning furnaces. Fuel in the typical plant reaches the furnace by conveyor and is dropped by gravity directly from the conveyor. Its rate of feed varies greatly depending on (1) source of supply that might in itself be irregular (2) opening of slide gates in the conveyor supplying fuel to adjacent boilers. For example, if a fireman increased slide-gate openings on one upstream boiler, fuel supply to down-stream boilers might fall off because supply drops.

This requirement meant constant supervision and careful operation for good results. For the usual installation, just looking into the furnaces of a battery of boilers showed marked differences in amount of fuel. There seemed no practical way to get the desired uniformity in feed with the slide-gate arrangement. And without uniform feed, fuel-air ratio was bound to vary badly.

New Feeder Design. So a special feeder was developed with a variable-speed driver. The conveyor merely serves to keep the feeder hopper full. Actual rate of feed from hopper to furnace is controlled by feeder speed. The feeder may be of rotary, chain or screw type.

The hopper for this special feeder is built to hold enough fuel for normal interruptions in fuel supply. The fire picks up rapidly, usually without manual attention, even after a 15- to 20-minute stoppage, roughly equal to the older pileburning furnaces.

With this feeder arrangement, combustion-control equipment could be put in and fuel-air ratios maintained. Despite wide variations in sizing (preferred 1½ in. top size) and moisture content of fuel (up to 55%) over-all efficiencies increased markedly.

An over-running type of distributor was developed along with the feeder. It had heavy steel blades welded angularly to a steel drum. The drum was mounted on a shaft running in roller bearings with ample clearance over the blades. This gave a rugged design capable of handling oversized material and tramp iron without damage. Further, it could use coal as an auxiliary fuel.

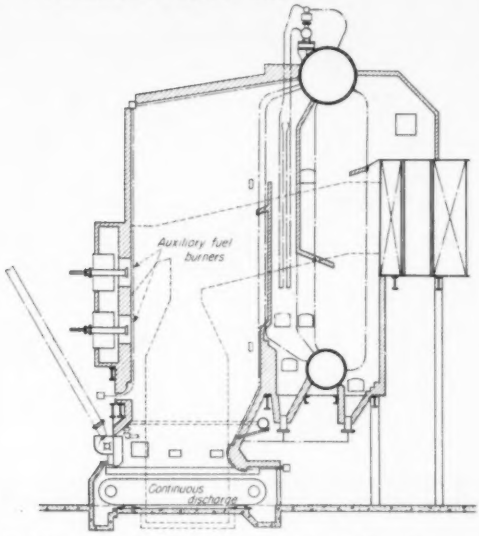
Fig. 5 shows furnace designs of typical installations where gas or oil burners can be used as auxiliaries with a maximum efficiency with these fuels.

Operating Experience. When handled properly, these units have built up good operating records. With spreader-stoker firing both continuous discharge and dumping grates have worked out well. Choice depends on (1) percentage of ash in refuse fuel (2) size of boiler unit. With the continuous discharge the grate moves very slowly, just fast enough to keep the ash-bed thickness at the desired one- or two-inch level.

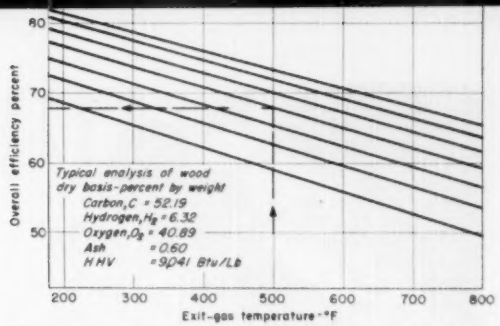
Furnace operation stays the same with either continuous or dump grate as far as fuel bed and air flow go. Uniform, level beds give best performance in either case. With the dump grate, fires are cleaned generally once each shift, a section at a time. This leaves an active fire on the rest of the grate so there is little or no loss of boiler output.

When fuel-air ratios are closely regulated high over-all efficiencies result. With air heaters or economizers this type of firing has at times developed efficiencies of 75 to 77%. Some have operated with as little as 15 to 20% excess air without CO, as compared to the more usual 50 to 100% excess or more.

. . . OR INTO THE LATEST UNITS



5 Latest hogged-fuel spreader-stoker installations have up-to-date furnace designs, can fire oil as an auxiliary fuel



6 Mixture of wet bark, sap chips, veneers, ranging in moisture from 3.4 to 50% or so, can be fired with good results

CHARACTERISTICS OF REFUSE FUEL

Sample	Type	Relative moisture, % by weight
1	Bark	35.7—47.2
2	Sap chips	48.6
3	Wet veneers	26.6
4	Core chips	19.6
5	Dry veneer	4.3
6	Plywood	3.4
7	Hardboard	5.9

Average weight per cu ft (5 samples)—17.08 lb

With this smaller air quantity boiler-draft loss drops and the boiler can produce at higher outputs.

In the preferred arrangement the stoker goes right under the boiler, Fig. 5. The conventional combustion chamber is entirely eliminated. By introducing the fuel into a hot furnace with a mechanical distributor a flash drying effect takes place. Fuel particles either start burning when they are in mid-air or as they land on the grate. Temperatures of over 2000 F have been observed a foot or two above the fire.

Fuel bed is level instead of forming a pile. There is no accumulation of ash except on the grate. If desired, cinder carryover can be reinjected for reburning. Thus, periodic cleanouts are avoided and the boiler stays on the line for months at a stretch.

The close-fitting grate, 2 to 3% air space, holds the protecting layer of ash on the surface so grate maintenance, even with 350-F air, runs very low.

Fires may be started with little or no preheating of the furnace. Oil-soaked kindling in the front or rear portion of the grate is enough to start ignition. It spreads rapidly over the whole grate and fuel burns from the bottom up.

Pacific Veneer Plant. About a year ago Pacific Veneer and Plywood Division of Canadian Forest Products, Ltd. installed a hardboard mill. Much of the veneer and plywood scrap, as well as core chips, formerly a boiler-room fuel, now go into the new product. So to carry the old steam load and the addition put on by the hardboard mill, this company had to go outside for hogged fuel from an affiliated lumber mill. The incinerator became a thing of the past.

Sander dust has helped carry the load for limited periods. But plans are under way to briquet or otherwise dispose of this material for industrial use. So some steps had to be taken for more efficient burning of available fuel.

Their first stoker, Fig. 4, went in with this idea in mind. It consists of a single, over-running spreader with its distributor three feet above the grate, 4 ft, 6 in. wide by 10 ft long. Furnace runs 9 ft wide. Normal design for a furnace of this width calls for two spreader units with a divided grate to make cleaning easy. With this one the fire is cleaned once each shift, during light or moderate loads. So far no difficulty has developed.

Because the fuel-ash content is low, Pacific Veneer put in a dump grate rather than a continuous grate design. Cleaning is only a matter of five minutes or so from start of burn-down to a fully re-established fire.

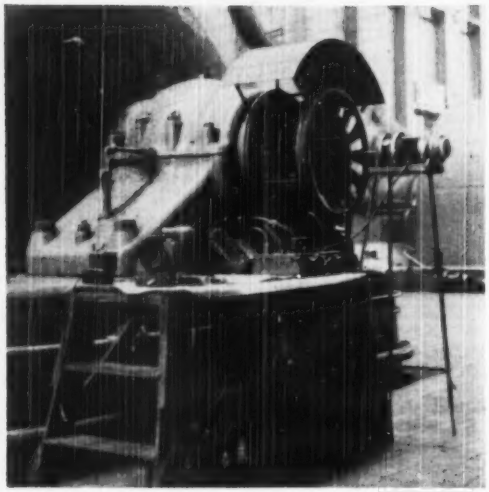
Fuel Handled. The fuel comprises various percentages of wet bark, sap chips, wet veneers, core chips, dry veneer, plywood and hardboard scraps. They range from 3.4 to 50% and more in moisture. Size varies from sawdust to whatever would pass a 4-in. center bar screen mounted in the conveyor bottom. Fig. 6 and the table give the principal characteristics of these fuels.

Fir, hemlock, mahogany and cedar have all been fired with equal success. Variations in moisture and sizing, of course, affect required feed rate. But, surprisingly, they have little effect on furnace performance.

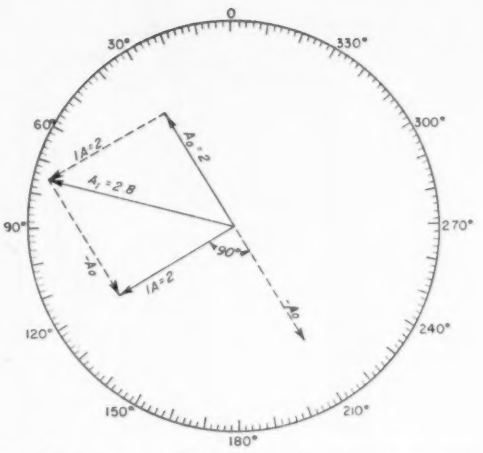
Because the original boiler was set too low to permit putting the stoker right in the combustion chamber the dutch-oven extension was retained, Fig. 4. But the brickwork is not expected to suffer at all from the stoker heat because (1) it is uniform (2) there is no danger of spalling from an inrush of cold air through roof and door openings, unavoidable with pile burning.

Automatic combustion control is now going in. Even without it, experience has been so good that the management has ordered a second similar stoker. Boiler output has doubled.

One experienced operator who visited the plant had this to say: "They were using the stoker to take the full swing of steam load on the plant. I have never seen a stoker-fired unit respond to a swing load as fast. The steam-flow meter would go from practically 0 to 20,000 lb per hr in, I would say, a matter of minutes. Of course, when unit came out of swing, it would give the stoker time to build up a heavy well-ignited fuel bed while waiting for the next swing. It looked to me like spreader stokers had all the advantages on this operation."



1 Field-balancing apparatus coupled to unit shaft through clutch analyzes bearing vibration with instruments on table



2 Vectors show relative vibration with angles giving clues to best location for placing the needed balancing weights

MECHANICAL VIBRATIONS

Balancing Rotors–3

This final installment of the series gives the once-over of fundamentals in figuring balancing weights for vibrating rotors. Many factors affect a machine's behavior under load

By **IRA E CHURCH**, *Field-Balancing Service*

► GREAT ADVANCES have been made in balancing equipment during the last few years. There have been improvements in both vibration pickups and instruments measuring vibration phase angles. Fig. 1 shows modern equipment using a sinewave generator coupled to the shaft, to develop a voltage wave matching the one created by a magnetic vibration pickup. The sine-wave generator field is rotated to bring these two waves in and out of phase to locate the high-spot reading.

In my set I added a clutch so it can be connected and disconnected to a turbine shaft without shutting down the unit. Vibration readings can be taken at any time without disturbing operation. A wattmeter measures both phase angle and vibration amplitude of shaft.

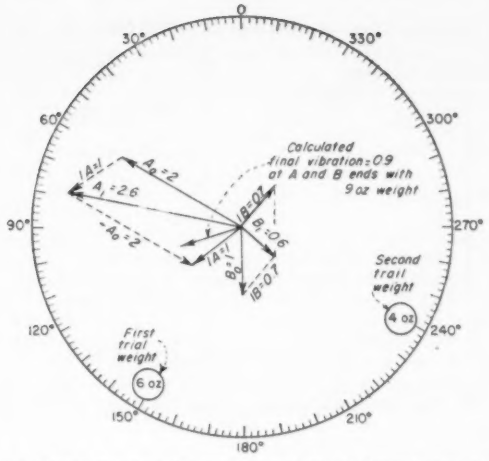
How to Balance. We don't have the space here to go into all the details of balancing turbines, fans, generators, etc. You'll probably get a better idea of what it's all about if we just go over the highlights of some simple examples.

Fig. 5 shows a disk mounted on a shaft supported in two bearings. When perfectly balanced the disk spins at any speed without causing excessive vibration at the bearings. Now, let's add a weight and spin it again. At some speed the bearings begin to vibrate. Vibration increases with speed, reaching a maximum at the critical speed of the rotor. At higher speeds vibration decreases and stays nearly constant above a speed about 1½ times the critical.

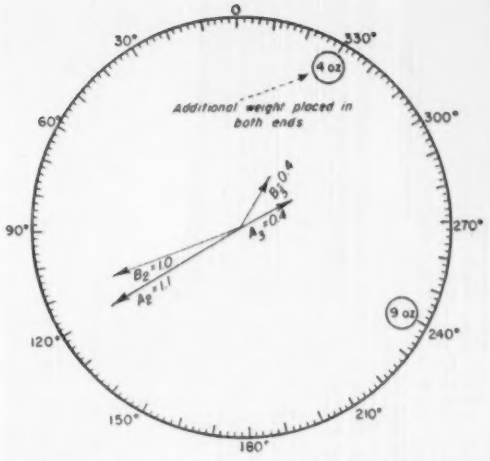
With the balancing equipment of Fig. 1 we can read the vibration as an arbitrary number of units at some specific angle. Suppose the reading for the vertical vibration is 2 units at 30 deg for each bearing. I would record this as 30×2. This vector is plotted as A_0 in Fig. 2. To balance out this vector we could add an equal weight 180 deg from the first at the same distance from the center. In an actual case, though, we wouldn't know the location or size of the weight. So after getting the original unbalanced reading A_0 we would place a trial weight on the rotor and take a second reading.

In our example, suppose we add another weight of the same size and moment to the rotor but place it 90 deg from the first weight. We then get a vibration reading of 2.8 units at an angle of 75 deg, or 75×2.8. This is plotted as vector A_1 in Fig. 2. Now, if we don't know the size and location of the first weight, we can deduce it by the vectors A_0 and A_1.

A_1 is the resultant of the two weights, while A_0 is caused solely by the "unknown" weight. By vectorially subtracting A_0 from A_1 we get $1A$, which measures relative location and size of the second or trial weight. This shows it to be 90 deg behind the unknown weight and of equal size or moment. We can immediately conclude that the trial weight is the correct size to balance, but should be moved 90 deg behind its first trial position. It then swings $1A$ into the position of $-A_0$ and the rotor is in perfect balance. A final check run proves this is correct.



3 Vector diagrams for two bearings of unbalanced rotor in Fig. 6 indicate the presence of dynamic unbalance in disks



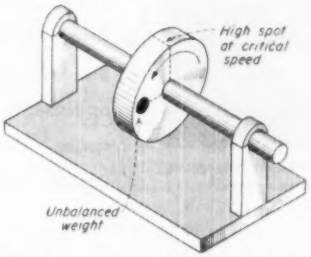
4 Vector diagram for last two moves in balancing multidisk rotor shows a small residual vibration at both bearings

We have talked here of taking just one vibration reading at each bearing. Actually vertical, lateral and axial vibration readings should be taken each time at each bearing. Separate sets of vectors are worked out for each vibration direction and the trial weights are moved to get the best compromise between the three sets of vectors.

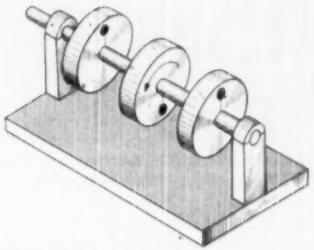
Multidisk Rotor. Let's consider Fig. 6, which roughly resembles some turbine rotors. Suppose all three disks are out of balance, but balance weights can be added to the two end disks only. Let's consider just the vertical vibration readings and how they suggest making trial weight moves. We will call one end of the rotor A and the other B, with the vectors similarly labeled. A_0 and B_0 are the vectors read on the original run, A_1 and B_1 the vectors with the first trial weight, A_2 and B_2 the vectors with the second trial weight, etc.

The original run gives us the following information: $A_0 = 60 \times 2$, and $B_0 = 180 \times 1$. So we plot them in Fig. 3. Since the rotor is symmetrical and the A end has the largest vibration, we'll place a trial weight there. We don't know the angle of lag, but the vibration won't change too much if we assume it as 90 deg. So we place a weight of 6 oz at 150 deg as shown schematically in Fig. 3. The rotor is run up to speed and we get this set of readings: $A_1 = 80 \times 2.6$, and $B_1 = 226 \times 0.6$.

Original readings indicated a dynamic unbalance because of the large angle between A and B vectors. Now, when we vectorially subtract A_1 from A_0 and B_1 from B_0, we find the components $1A$ and $1B$ in practically opposite phase, confirming the dynamic unbalance.



5 At critical speed high spot lags heavy spot on rotor by angle of 90 degrees



6 Multidisk rotor with unbalanced weight in each disk needs expert analyzing

With our past experience and a little figuring we decide to increase the trial weight to 9 oz and move it 90 deg ahead. We conclude this will bring $1A$ and $1B$ vectors together to equal 107×0.9. Theoretically this should wipe out the dynamic unbalance leaving a static unbalance, probably in the middle disk.

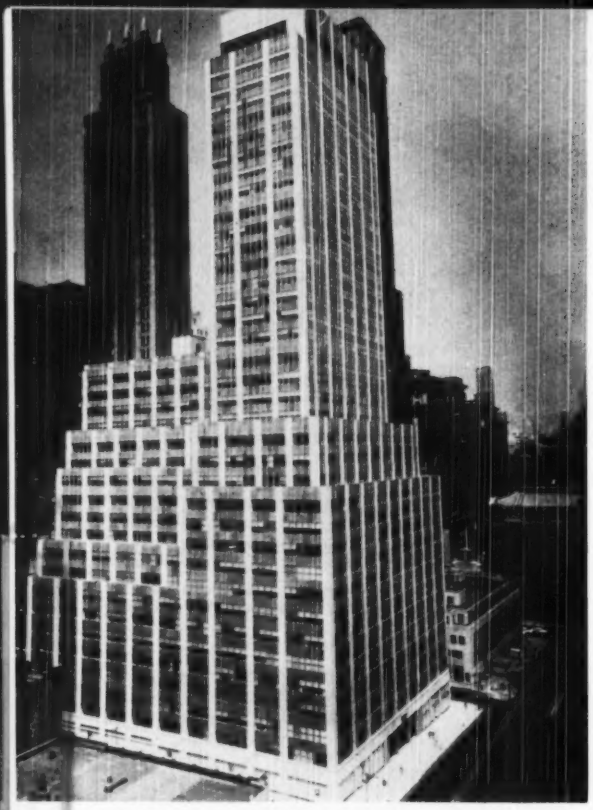
Making the run we read $A_2 = 120 \times 1.1$, and $B_2 = 110 \times 1.0$. These are plotted in Fig. 4. The vectors are not exactly as predicted but they are satisfactorily close.

To handle the residual static unbalance, a weight can be put in each end of the rotor at the same angular position. If the weights need adjustment, both are usually moved together to similar positions. By inspection we decide that for the A end this weight should be put at 330 deg, or opposite the 150-deg position of the first trial weight. We judge that a 4-oz weight would probably do the trick, placed as indicated in Fig. 4. The 9-oz weight stays at 240 deg or combines with the 4 oz making 10 oz at 266 deg.

On the next trial run we get readings: $A_3 = 300 \times 0.4$, and $B_3 = 330 \times 0.4$. These vectors together with the preceding ones are shown to a large scale in Fig. 4. We have slightly overshot the mark by using 4 oz, but in light of practical tolerances we can consider the unit satisfactorily balanced. A slight improvement can be made by reducing the 4-oz weights to 3 oz and moving the B weight backward by about 15 deg.

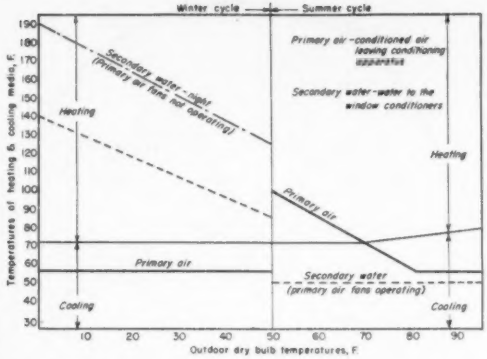
Conclusion. All we have intended to give in this series is a quick picture of the main problems and how they are handled. Balancing, however, is not so cut and dried as it might appear from the two simple examples discussed. Balancing should not be hurried for large

(*Continued on page* 202)



1 Thirty-six story building has a 2000-ton refrigerating plant, also cooling towers, and zoned air conditioning

BOTH WATER AND AIR SERVE AS...



2 Because outdoor air above 50 F has too little cooling capacity, system switches to water above this temperature

Fully air-conditioned office buildings bring higher rents but you have to prove the extra income balances equipment cost, operation, loss to equipment of rentable space. H S Lewis, of Jaros, Baum & Bolles, tells how system pays its way

Air Conditioning at 100 Park Ave

► EACH ELEMENT of an office building must be analyzed to determine how much it contributes to expected revenue. Unlike sanitary facilities, illumination and heat, comfort air conditioning has yet to receive full recognition as an elementary requirement in a modern building. Funds for its acquisition and operation are not expended as a matter of course, but must, more than any single facility of a commercial building, be justified economically.

In planning air conditioning for the 36-story office building at 100 Park Avenue, within a block of New York's Grand Central Station, Fig. 1, four factors had to be brought into economical balance: (1) Additional investment for air filtering, cooling and dehumidifying equipment. (2) Additional cost of operating this equipment. (3) Loss of rentable area because of equipment's space needs. (4) Additional revenue possible from summer air conditioning.

To this end, three schemes were given consideration:

SCHEME A provided for a chilled-water plant in the cellar and a set of chilled-water, steam, vacuum-return, condensate, and electric risers, with outlets on each floor. Tenants desiring air conditioning would install their own equipment within their space, connecting to these utilities. A separate steam-heating system, employing enclosed fin-type radiators with manual damper control, was contemplated as part of the owners' work.

SCHEME B differed from *A* only in that complete air-conditioning systems, instead of being provided by tenants, were furnished by the owners. An equipment room with multizone conditioning apparatus was planned for each of the 35 office floors. Each equipment room on the 19 lower floors required an average of 1200 sq ft floor space, with about 650 sq ft for the typical tower floor. Aggregate loss of rentable area chargeable to air conditioning under this plan was about 33,000 sq ft.

SCHEME C consisted of separate air-conditioning systems for exterior and interior spaces of building, a chilled-water plant equal to that in *A* and *B*, with heating provided by the exterior zone air-conditioning units under the windows. This required a total of 12,000 sq ft of apparatus room space on 9 floors between the cellar and 20th floor.

An analysis of these schemes led to the following conclusions:

1. A fully air-conditioned building commands higher rents than one providing only the utilities for operation of tenants' own installations. On the basis

...PART OF THE SYSTEM'S FEATURES

TWO CENTRIFUGAL REFRIGERATING COMPRESSORS—1950 ton total—use up to 6000 gpm condensing water routed to two cooling towers. Compressors handle 3900 gpm, cool it from 53 to 41 deg, distribute it to 14 surface dehumidifiers, 1 shell and tube heat exchanger, Fig 4. Refrigerating capacity averages 3.5 tons per 1000 sq ft conditioned area.

MAXIMUM PURCHASED STEAM LOAD—35,400 lb per hr for winter heating and ventilation. Refrigerating plant has 1150-hp steam turbines driving the compressors and takes about 35,000 lb per hr of steam for the summer peak.

TWO-ZONE CONDITIONED-AIR SUPPLY—Exterior, Fig. 3, uses Carrier Weathermaker window units. Interior takes up to 223,000 cfm for an average of 0.75 cfm per sq ft of conditioned area, interior zone. Exterior zone takes 152,000 cfm of conditioned or primary air, and 456,000 induced for a total of 608,000 cfm, and an average of 2.44 cfm per cu ft of conditioned area, exterior zone.

TWO-ZONE, TWO-METHOD SYSTEM—window units and duct—requires only about 2.8% of total conditioned area for equipment. Window units handle up to 3600 gpm of secondary water, Fig 4; in heating season act like hot-water system.

of *A*, a portion of the tenant's space must be set aside for air-conditioning equipment, reducing useful floor area of a given rental unit. Since rents are paid on the entire area regardless of use, an unfavorable element from a renting point of view is created. Legal ventilation needs constitute another factor. Window areas of this building are large enough, in relation to floor area they serve, for proper ventilation. But only if no interior (windowless) spaces are created by partitioning. Manifestly, building owners cannot prevent tenants employing the layout best suited to their needs, so interior spaces must be expected. Ventilating systems of considerable extent would have to be put in. An incremental investment of this character yields no extra return even remotely comparable with that of a fully air-conditioned structure. All these factors caused serious consideration for the other two schemes.

2. A separate air-conditioning system for each entire floor—the so-called "conventional system"—has for many years been a popular method of treating an office building. Such systems are limited to control by zones, rather than by individual rooms. They require horizontal ducts of considerable size extended through the entire space on each floor resulting in extensive furring of ceilings. In this project it might total 300,000 sq ft. If a given clear headroom was to be maintained, a lower story height would be possible by this arrangement—serve only the interior spaces by horizontal duct systems and condition the peripheral areas with under-window units.

3. Apart from these factors, final decision was influenced significantly by budget estimates for *B* and *C*. They revealed the initial cost of *C* as about 10% less than that of *B*. Elimination of a separate heating system by using exterior under-window units for year-around conditioning helps make this possible.

LOAD ANALYSIS

1. Exterior Systems. A strip 15 feet wide, paralleling the outside walls, was considered, subject to outdoor-weather influence. We designate it here as "exterior" or "peripheral" zone. In spaces of this nature usual procedure assumes an outdoor dry-bulb temperature criterion of 65 deg—heating being required below and cooling above that temperature. This is so because: (1) during occupancy period there exists an internal heat-gain due to people and lights (2) total effect of the weather—even on relatively cold days—may be that of a net heat gain on one side from direct sunlight.

Significantly, average noon dry-bulb temperature for the year in New York City is 56.8 deg, equal to that of spring and fall (table on p 93). Average number of sunshine hours in spring and fall is 837; in summer it is 1088. Thus, there are 77 hr of sunshine in the so-called "in-between" season for every 100 hr in the "legitimate" cooling season. Taking account of the smaller number of daylight hours in spring and fall, we find the sun shines 59% of all daylight hours, compared with 66% in summer. Further, because of variation of the sun's angle of altitude through the year, the heat quantity received by the South's vertical surfaces reaches its maximum in December—a time of year intuitively associated with "heating" in northern latitudes. So at any time, the resultant of sun effect, internal heat gain, transmission loss, and infiltration loss may constitute a cooling load.

This means that at a given time a net cooling load may exist on one or two facades, while heating is required for other exposures. To realize controlled temperatures, both heating and cooling must be available on all but hottest days.

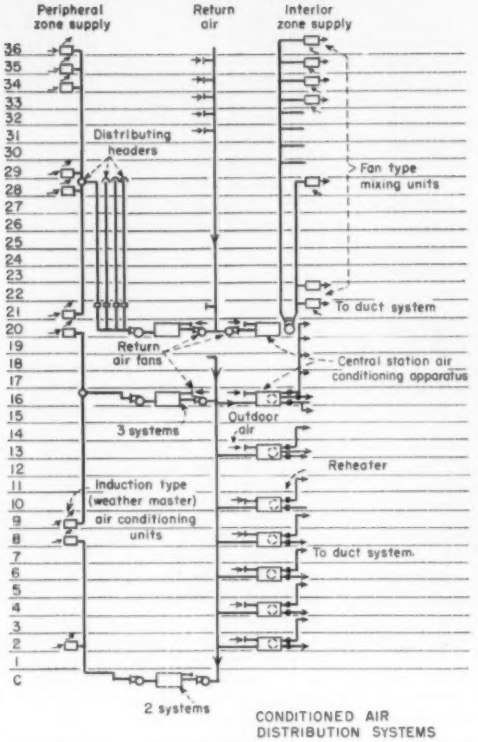
Translating these considerations into terms of physical equipment, air-conditioning units are provided for windows of all facades. During the period of occupancy a fixed quantity of treated air and a variable quantity of water are supplied to each unit from central equipment.

Air and water temperatures, Fig. 2, reveal that for outdoor dry-bulb temperatures less than 80 deg, one of the two is above (heating) and one below room temperature (cooling). Reversal of roles of air and water as sources of heating or cooling takes place at a switchover point in the neighborhood of 50 deg. This switchover temperature is established primarily by the fact that above it, air from outdoors, in the quantity obtainable, has insufficient cooling capacity.

2. Interior Systems. A much simpler task is the analysis of the interior zone loads. Two basic heat sources only need be considered: lights and people. Lights represent more than 80% of this load, which greatly simplifies the control problem. In interior office spaces, lighting requirements seldom vary. If they do, it is from occasional changes in office layout and space assignment. Typically, lights are turned on at start of working day and operate continuously until office hours end. Prevalence of fluorescent lighting is added insurance for continuing this practice. Lamp life is not only a function of lamp operating hours but, in addition, depends significantly on the frequency of switching.

With this assurance of load stability, the only variations requiring special study occur in spaces containing business machines or other special equipment, and in those for high-population densities, such as conference rooms. These cases are due to individual tenant needs and cannot be considered in the basic building design, except as considerations of capacity and flexibility of the distribution systems. Once the basic balancing of the interior zone system is completed, a practically constant cooling load must be anticipated, and no zoning or individual room control is indicated. Not only will load variations during the operating day be negligible but the load will also be fixed regardless of season, even though tenants may desire some adjustment of room temperature.

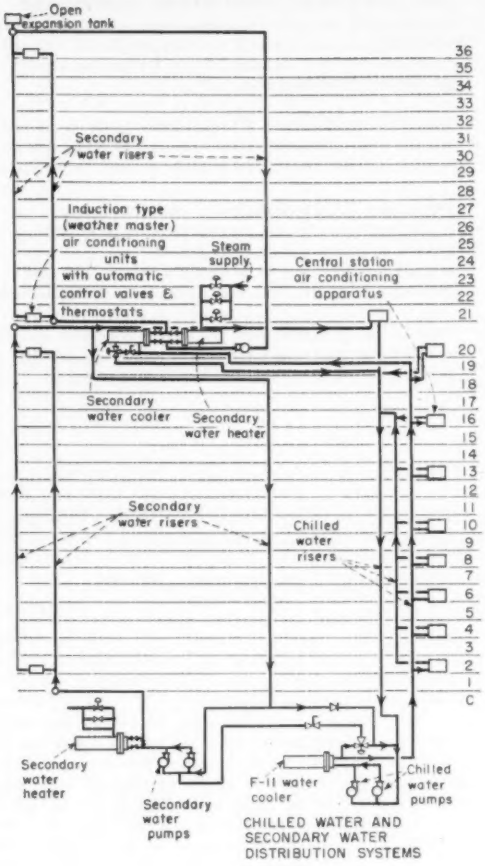
DIRECTION AIR MOVEMENT TAKES



CONDITIONED AIR DISTRIBUTION SYSTEMS

3 To cut down air-conditioning equipment and ductwork space, the load was divided into both external and interior zones

PROPER PIPING REDUCES PRESSURE



CHILLED WATER AND SECONDARY WATER DISTRIBUTION SYSTEMS

4 Special piping arrangements for the secondary water to the window conditioners permit low-pressure fittings, valves →

So reheat for each of the large floors is primarily to prevent too great room-temperature drop in the first operating hour each day, before illumination energy is converted into air-temperature rise. Second, reheat precludes the possibility of condensation on room and duct surfaces. Typically, the individual floor's reheat-coil steam control valves modulate the steam supply to meet the demands of a floor return-air duct thermostat. Because the total interior floor area of the 16 tower floors is relatively small (it approximates that of two typical floors in lower part of building), only one common reheater was provided to serve that zone. In two instances—where interior spaces occur under roofs—the roof heat losses are offset by small booster heating coils.

Besides fitting in the air conditioning several miscellaneous ventilation systems had to be included. Refrigeration-machine room, steam meter and switchboard rooms, locker room needed an air supply. These same rooms, plus elevator-machine rooms, kitchens, etc, needed exhaust systems.

SYSTEM DESIGN

The functional considerations above dictated design of the various systems. With the architects' close cooperation they were then integrated into the building design. All air and pipe shafts are part of the service core and all fan rooms are joined to it. Splitting air-conditioning ducts within the fan rooms is fairly easy because the service core is centrally located. This permits reasonably small trunk ducts and eases headroom conditions.

Exterior Air Conditioning. Central apparatus for window air-conditioning units is in the cellar and on the 16th and 20th floors, Fig. 3. Small interior-zone apparatus rooms on the 2nd, 4th, 6th, 8th, 10th and 13th floors have each a floor area of 660 sq ft and serve the 2nd-14th floors. Interior spaces above the 14th are served by equipment housed in the 16th and 20th floors' fan rooms mentioned above.

Conditioned primary air is distributed to the window-type air-conditioning units through several networks of round ducts. Average air-pressure drop through each of these systems is eight inches wg. For each cubic foot of primary air supplied to the window units, three cubic feet are drawn into the unit from the exterior rooms by aspiration. Depending on room requirements, this room air is (1) cooled or heated by contact wtih a one-row finned coil, (2) mixed with primary air (3) discharged

into rooms through sill grilles. These three cubic feet of room air would in a "conventional" air-conditioning system be returned to the central apparatus, and a part bypassed around the dehumidifier. With the high-pressure peripheral system this isn't done. So duct sizes are kept very small, because (1) only one fourth the usual air quantity is transported to and from the conditioned space, and (2) air flows through the primary duct system at high velocities and pressure drops.

Interior Air Conditioning. Similar considerations underlie the design of the interior-zone duct system for the 16 tower floors. To obtain minimum duct sizes, only the amount of air that must actually pass through the dehumidifier circulates through supply and return air risers. Pressure drop of 4½ in. wg occurs between outdoor-air intake and the supply-riser outlets. While local recirculation at the window units is achieved by induction nozzles in each unit, an interior-zone-fan mixing unit on every tower floor blends treated primary air with recirculated air.

Interior-zone distributing duct systems for the lower 19 stories operate at conventional velocities and pressure drops. Their return-air ducts convey air (not exhausted through toilets or elevator machine rooms) to a central shaft. From here fans in 4th, 6th, 8th, 13th floors apparatus rooms take part of this air to the conditioning apparatus and spill the remainder outdoors, Fig. 3.

Lobby Air Conditioning. A cabinet unit in one of the cellar fan rooms conditions the lobbies. Chilled water from the main system is the cooling medium. In the heating season, this unit assists the entrance heating systems by maintaining an outward pressure on first floor.

Store Air Conditioning. Character of first-floor and cellar stores was not known when building plans were completed. So no air-distribution system was developed. Rough estimates indicated the cooling load of these spaces would be about 200 tons of refrigeration, about 20% of capacity of one refrigerating machine. Usually, stores in buildings of this type close later than the offices. This is particularly true for restaurants, which must be considered in the basic planning. It did not appear advisable, therefore, to select centrifugal refrigerating machines large enough to absorb this additional load. Instead, a separate condensing water pump was provided, for use when the building's central plant is shut down. It will serve individual reciprocating condensing units to be purchased and installed by each store tenant. Outdoor-air intakes, steam mains, and electric feeders are sized for these future loads when they develop.

NOON D-B TEMPERATURES

Average, New York City

SEASON	MONTHS	DEGREES F
Spring	April-May	56.8
Summer	June-Sept	75.8
Fall	Oct-Nov	56.8
Winter	Dec-March	37.9

Summer weather data—Marley Co

Entrance Heating. Main lobby contains revolving doors, which introduce air from outdoors, in the manner of pumps, and nearly independently of wind pressure. To heat this mass of air to room temperature, two air-heating units over the doors supply blasts of hot air through grilles in the ceiling of each revolving door. The same units also blow air into the vestibules flanking the main doors. In cold weather the chimney effect of a 36-story building combines with wind pressure to cause considerable infiltration through swinging vestibule doors. For this reason, the lobby's air-conditioning system described above (which can handle up to 100% outdoor air) is designed to create an outward pressure in the lobbies.

Chilled Water. Water is chilled by two centrifugal refrigerating machines developing a total of 1950 tons. Their Freon-11 compressors are driven by 1150-hp steam turbines; 3900 gal water per min are cooled from 53 to 41 deg, and distributed through a reversed-return piping system to 14 surface dehumidifiers and a shell-and-tube heat exchanger, Fig. 4. The latter serves the tower peripheral air-conditioning system.

Secondary Water. To maintain reasonably small riser sizes, and to make possible low working-pressure coils, fittings and valves, the water-distribution network serving the under-window air conditioners (also known as "secondary water" system) divides into two circuits. One supplies 2nd to 20th floors, while the other serves the tower, Fig. 4. Each circuit comprises circulating pumps, steam-operated hot-water converters, and an up-feed, reversed-return piping system. When required, cooling effect for the lower secondary water circuit is obtained by bleeding a controlled amount of water from the chilled-water system into the suction of the secondary-water pumps. Secondary water for tower floors is chilled in a heat exchanger on the 20th floor, using chilled water as the cooling medium. One out of every four window units is equipped with a thermostat, in the induced-room-air stream ahead of the cooling-heating. Measuring room temperature the thermostat actuates the throttling-type water-flow control valves, which are a part of each unit. For nights, weekends and holidays (when primary-air fans are not operating) during the heating season hot water at increased temperatures can be pumped through the window-unit coils. The latter then function like a hot-water heating system.

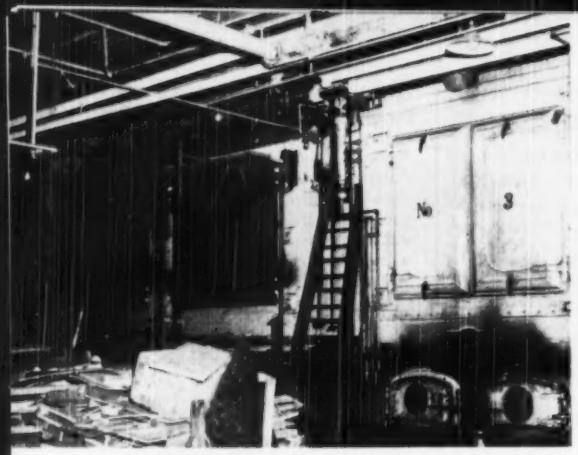
Condensing Water. Six-thousand gal of condensing water per min are pumped to a 4-cell induced-draft cooling tower (above 36th floor) by three pumps. A spare pump is provided and valved to provide breakdown protection for either the condensing-water or the chilled-water pumps. All water circuits are provided with strainers. In addition to these, filters in each of the secondary water circuits continuously handle 10% of water circulated.

Steam. Where high-quality utility steam is available at reasonable rates, the investment, space requirements and operating expense of a steam-generating plant can usually be justified only over a period of many years. After the break-even time, replacements due to obsolescence or wear may further delay the advent of a return on the added investment. This is particularly true where special rates can be obtained in consideration of seasonally balanced demand. In this instance, the turbines, selected as prime movers for the centrifugal refrigerating machines, require 35,000 lb steam per hr at maximum load. This represents about 70% of maximum steam demand for a day when outdoor temperature is zero degrees.

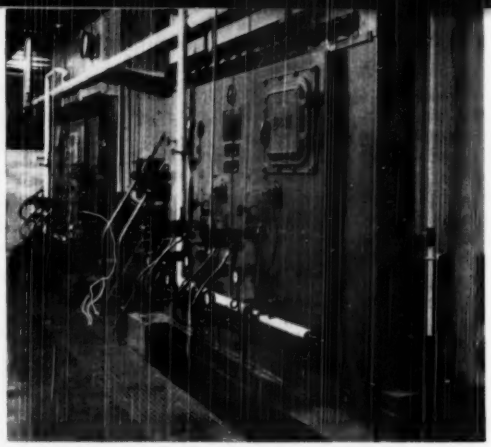
As a result of the foregoing considerations, it was decided to use steam from the mains of New York Steam Corp. Steam at full street pressure (125 to 145 psig) goes to the turbines, after first passing through separators to ensure high quality. It exhausts at 4 in. Hg and condenses in surface condensers with 2-stage ejectors. Condensate from the condenser hotwells discharges to the city sewer. Water leaving the refrigeration condensers serves as the condensing medium for the steam. In the event of vacuum failure, an atmospheric relief valve at each steam condenser permits escape of steam to the low-pressure steam riser. Should flow be in excess of the steam-system condensation rate, a backpressure valve at top of riser permits steam to escape to atmosphere.

Steam pressure for air conditioning, ventilation, space, and utility water heating, is reduced in two stages, first to 40 and then to 5 psig. A valved outlet is provided on the 40 psig header, as

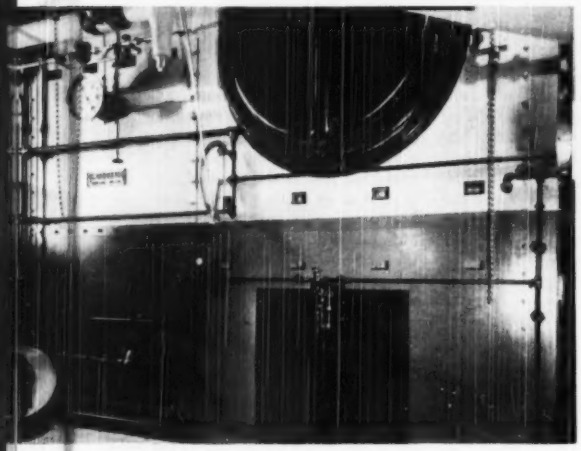
(*Continued on page* 184)



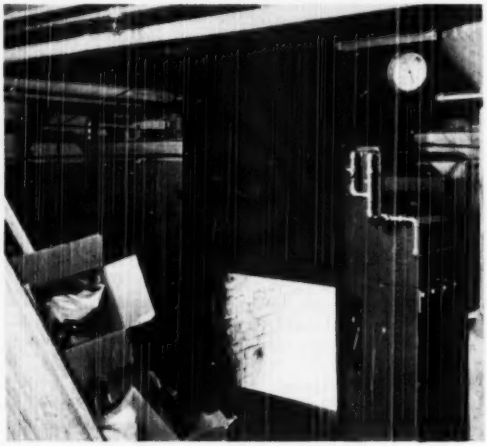
OLD LOW-HEAD BOILER ROOM was dismantled and new one put in its place. New incinerator carried load during change



TWO OIL-FIRED BOILERS, 22,000 lb per hr, team up with the 3200-lb-per-hr hrt incinerator unit for full load in winter



HEAT RECOVERY from incinerator takes place in right half of unit, above. It's a standard hrt firetube boiler, oil fired



TRASH DISPOSAL, on left side of unit, occurs through a floor-level, guillotine-type charging door, 4 ft wide by 3 ft high

How to Make an Incinerator Pay

By designing a heat recovery boiler connected to a dutch oven, Sears Roebuck, Seattle, can carry its summer steam load, save on year-round fuel needs with incineration. W E Brooks, bldg supt, tells how the recovery unit was fitted in the plant and how it works

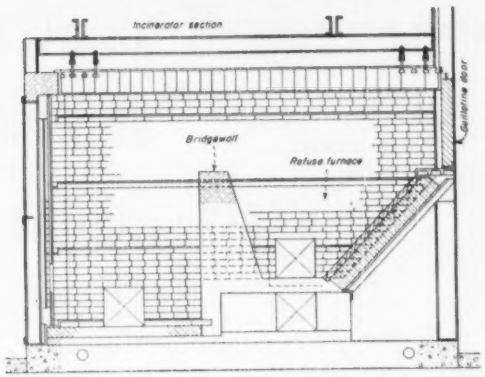
► SINCE THE WAR, plants of all sizes and descriptions have had to modernize their power plants. We faced the same general problem but had to unravel a few special kinks all our own. And one of the biggest was what to do about the disposal of waste paper, rubbish, wood crating. Should we sell it, burn it, pay to have it hauled away?

Offhand, the first questions that come up are: How much of a problem is our rubbish? What is the size of our plant? The Seattle, Wash. plant of Sears, Roebuck & Co serves the entire Pacific Northwest and Alaska. In one building with a floor space of 1,000,000 sq ft, we house a mail-order department, our control store and a retail store. Just to keep them going requires a good-sized power plant.

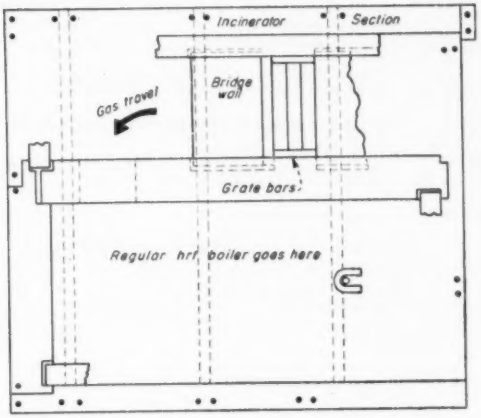
Every day we get in carloads of merchandise, mostly packed in wooden crates or paper cartons. We have to repack most of it for direct mail to our customers or delivery to our other retail stores in the area. The waste piles up and becomes a major disposal problem.

For years we baled all waste paper and cardboard boxes in a small down-

Recovering Incinerator Heat



DUTCH-OVEN SECTION, of trash-disposal unit, *left*, burns waste; hot gas passes over bridgewall, crosses over, *below*



GAS TRAVEL from dutch-oven section parallels heat reclaiming firetube boiler, then goes through the firetubes to stack

stroke baler. Wooden crates and any other combustible waste we burned on the grates of our 1915 straight-tube boiler. Incidentally, we long ago changed over to oil but we left the hand-fired grates in for just this service.

We knew all along that while we got rid of our waste we weren't doing it very efficiently. Not only did we clutter up our firing aisle, but we also had to take time out to break down some of the waste pieces so they'd fit through the furnace door.

What's more, we couldn't fire the material at anywhere near an even rate. Sometimes because of the nature of the waste we'd have to hold the fire door open for long periods while we jammed it down on the grates. Everybody agrees that this firing method gives a poor efficiency, could cause smoking and should not, in any event, be encouraged.

After the war, things moved so fast we could no longer put off solving our boiler-room problems. We added new retail-store facilities, warehouse space, shipping and mailing rooms. Our boiler plant was hard put to meet the load. So when we decided to modernize we called in our architects and consulting mechanical engineer to solve all our boiler-room problems.

Boiler-Room Asset. The way we did the job is interesting and points up how we succeeded in converting our waste-disposal problem into a boiler-room asset.

We found we could save considerable money, both in first cost and extra operating labor, by pulling out our old boilers and putting the new in their place. Any plant operator can tell you that's not so easy as it sounds. Look at the first picture, p 94, which shows us dismantling the old boilers. You can see (1) how low a headroom we had to work in (2) how we had to keep the debris moving or be crowded out.

Once we had the old boilers out we solved the headroom difficulty and another one of subsurface leakage. To cover the new, higher boilers, we put in a canopy-type roof in place of the low, flat one. See plant-equipment table, p 96. This new concrete roof had to be reinforced and tied into the existing concrete structure in a way that would compensate for the stabilizing effect of the old roof slab. This we did.

Next we tackled the subsurface water-leakage headache. Our old boiler-room floor was several feet below tidewater level. Salt water seeped in and, through capillary action developed in the old brick settings, it climbed the boiler to attack pressure parts. Damage was severe.

To guard against this we put in a watertight copper pan first, and then poured the new boiler foundation on top of this pan. We waterproofed the entire remaining floor area and laid down a 6-inch floor slab over that.

What did we do about steam while we were tearing out the old and putting in the new boilers? We knew we'd be faced with this so before we did anything else we planned the trash-burning incinerator as the first part of the job. We put it in complete, and let it carry the summer steam load while we went ahead with the two new 22,000-lb-per-hr boilers.

The Incinerator. Because of the quantity of waste wood, paper, cardboard, we looked at each waste element before finally deciding what to do. Paper and cardboard, baled, could be sold. To handle the extra load of this material we bought an Economy up-stroke baler with a 500-lb capacity per feed.

For our other waste we first considered paying someone to take it away, and then went into the matter of burning it.

If we burned it we had several choices: (1) without heat recovery (2) with heat recovery in a dutch oven either attached to the main boiler or connected to a separate boiler.

Of these choices, the heat-recovery boiler connected to a dutch oven indicated a substantial saving of base fuel. We could do as well by burning the trash under one of the new, main boilers, but there were drawbacks. Wear and tear on the main boiler would be so severe that a separate unit would be much smarter.

Heat-Recovery Boiler. The unit that finally went in (photos, p 94 and drawing, above) has been set in a sub-

PRINCIPAL POWER-PLANT EQUIPMENT

Sears, Roebuck & Co, Seattle, Washington

TRASH-DISPOSAL UNIT:

Boiler, 1 ..... Puget Sound Machinery Depot
Horisontal return tubular, 3200 lb per hr, 160-psig design pressure, operated at 100 psig
Suspended walls ..... M H Detrick Co
Refractories ..... A P Green Fire Brick Co
Soot blower ..... Diamond Power Specialty Corp
Model F—Strait-Line
Feedwater regulator, 1 ..... Northern Equipment Co
1-in. Copes BI-Regulator
Oil burner, 1, Model SS ..... Leahy Manufacturing Co

MAIN BOILER UNITS:

Boilers, 2 ..... Babcock & Wilcox Co
Two-drum integral-furnace, 22,000 lb per hr, 160-psig design pressure, operated at 100 psig
Oil burners, 2 ..... Babcock & Wilcox Co
Y-Jet wide-range, forced-draft, steam-atomizing burners; 8-to-1 range with 90-psi oil and 100-psi steam
Safety valves ..... Manning, Maxwell & Moore, Inc
Nonreturn valves ..... Wm Powell Co
Soot blowers ..... Diamond Power Specialty Corp
Automatic valved, rotating units
Blowoff valves ..... Yarnall-Waring Co
Direct-acting straightway and seatless-angle valves
Steam gages (Ashcroft) ..... Manning, Maxwell & Moore, Inc
Feedwater regulators ..... Northern Equipment Co
Copes 2-in. regulators for 22,000 lb per hr at 20-psi differential
Water-level indicators ..... Reliance Gauge Column Co
Eye-Hye Model E-33
Forced-draft fans ..... Clarage Fan Co
One per boiler, motor driven, rated at 28,500 lb per hr at 105 deg F and 5.0-in. static pressure
Insulation ..... Johns Manville
"Superex" high-temp block, 85% magnesia block

EMERGENCY COAL-CONVERSION EQUIPMENT:

Stoker ..... Detroit Stoker Co
RotoStoker with dump grates
Flyash collector ..... Western Precipitation Corp
Type 9VG12, size 20-4 multiclone collector
Induced-draft fan ..... Clarage Fan Co
Motor driven, 33,000 lb per hr at 535 deg F and 3.3-in. static pressure

AUXILIARIES:

Feedwater heater ..... Cochrane Corp
One rolled-steel-plate, 30-psig Code construction for operation at 3-psi capacity, 30,000 lb per hr
Relief valves ..... Cochrane Corp
One 4-in. No. 1000 Multiport, one 6-in. No. 1200 Multiport; one 10-in. No. 1200 Multiport
Tube cleaners ..... Airetool Mfg Co
One No. 4250 and one No. 4200 air-driven cleaner
Feed-pump governors ..... Northern Equipment Co
Two 1¼-in. Copes type SL
Chemical feeders ..... Dearborn Chemical Co
Type T No. 64 turbine pump with Flexopulse timer
Combustion controls ..... Bailey Meter Co
Compressed-air-operated, automatic-combustion system of the steamflow-airflow type
Draft gages, Boiler meters, Level indicators, oil tank ..... Bailey Meter Co
Boiler feed pumps, 2 ..... Union Steam Pump Co
Existing pumps reconditioned
Metal protection ..... Dampney Co of America
Apexior No. 1 for internal boiler surfaces. Thurma-lox No. 7 for fans, boiler doors, and boiler fronts

FUEL-OIL PUMPING AND HEATING (assembled on job):

Pump, 1, heavy fuel oil, Pump, 1, duplex, reconditioned, Heaters, oil, 2, war surplus ..... DeLaval Steam Turbine Co
Control valve, 1 ..... Chas M Bailey Co
Controller, temperature, 1 ..... C J Tagliabue Mfg Co

ARCHITECTS, ENGINEERS & CONTRACTORS:

Architects ..... Young & Richardson, architects & engineers, Seattle
Mechanical consulting engineer ..... H W Beecher, Seattle
Equipment installation ..... C C Moore & Co, engineers, Seattle
Piping ..... University Plumbing and Heating Co, Seattle
Insulation ..... E J Bartells Co, Seattle

basement so trash can be fired at basement level. The firing point is guillotine-type charging door, refractory-lined, counterweighted, 4 ft wide by 3 ft high. A water piston under control of a 3-way hand valve operates it. With a door of this size, we dump whole cartloads directly into the furnace. This way, we keep our basement floor clear of scattered trash.

The dutch-oven section parallels the heat-reclaiming firetube boiler. This arrangement allows a separate, normal oil-fired operation of the heat-reclaiming boiler. The hot gas coming off the dutch oven travels its full furnace length over a relatively high bridge wall and crosses over to the reclaiming boiler firetubes for passage to the stack. Result is a flame travel long enough for complete and smoke-free combustion with the advantage of extra heat pickup.

We never burn both oil and trash together because the draft requirements are so different. The oil burner is of steam-atomizing design. We supply a natural draft through a checker-work floor and dampers at the front. The horizontal-return-tubular boiler has standard fittings.

Because dry-wood burning produces high furnace temperatures, our consulting engineer, H W Beecher, gave considerable thought to furnace-wall type and construction. While a gravity brick installation ran less in first cost, maintenance problems made a suspended construction the better choice.

The furnace floor is cooled by air passing through 4-in. tubes on 6½-in. centers in the foundation pad. One end of tubes opens into the boiler room. The other terminates in the area between brickwork and steel casing on the right-hand side of the unit. Several openings near the top of the casing let the exit air escape. Result is a stack effect that gives good cooling-air circulation through the tubes. The table shows results as well as unit dimensions.

TRASH-BURNING UNIT

Maximum steam output, lb per hr	3000
Boiler-operating press., psig	100
Boiler-design press., psig	160
Grate surface, sq ft	4.5
Furnace volume; cu ft:	
Primary furnace	292
Secondary furnace	404
Total	696
Exposed refractory area, sq ft:	
Primary furnace	313
Secondary furnace	425
Total	738
Flame travel:	
Refuse burning, ft	30
Oil burning, ft	16
Boiler-heating surface, sq ft	790
Tube length, ft	11.9
Tube diameter, in.	2.5
Soot-blower operating press., psig	90

Electronic Brains Supervise Passenger-Elevator Dispatching

Whether a building's traffic is heavier up, or heavier down, just setting a simple switch dispatches cars automatically in one of six programs to give prompt, efficient service. Even the forgotten man gets special attention

1 Electronic supervisory control dispatches automatically 18-passenger elevators in 100 Park Ave Building, New York

► HUMAN SUPERVISION of humans may be all right, but experience shows that for passenger elevators it is not the best. So several systems have been developed for doing this job automatically. Here we describe one of these, known as Autotronic by Otis.

Automatic Dispatching. This system does all and far more than an expert supervisor can do manually if he gives his entire attention to dispatching a bank of elevators. The control takes care of so many of the supervision details that the supervisor can give a large part of his time to the needs of incoming and outgoing passengers.

Simply by turning a dial the supervisor indicates to the control how the elevators are to operate. After that the supervisory system directs them to best serve the traffic needs.

Indicator Unit. A supervisory indicator unit, Fig. 2, forms part of the system. On the left in its top section is a column of up-direction green numerals, and on the right a column of down-direction red numerals. These numerals light when corridor buttons are pressed to show the supervisor where passengers are waiting on floors. When a car answers a call the light goes out.

Between these two columns are the amber landing numerals. As a car approaches a floor the corresponding numeral lights and then goes out as the car leaves the landing.

Below these numerals are two rows of arrows, the top ones green for up direction and the bottom red for down. When a car is making an up trip its green arrow lights and when coming down its red arrow lights.

Below these arrows a row of numerals remain dark except when a car operator holds down the nonstop switch. This usually means that the car is full and is expressing to the main landing.

Dispatching Lights. At the bottom on the left is the green up group-dispatching light, *U*. When lighted it indicates the next car to arrive at the bottom floor will immediately get an up dispatching signal.

The red group-dispatching light *D* on the right when lighted shows that the next up car to arrive at the top landing will be immediately dispatched down.

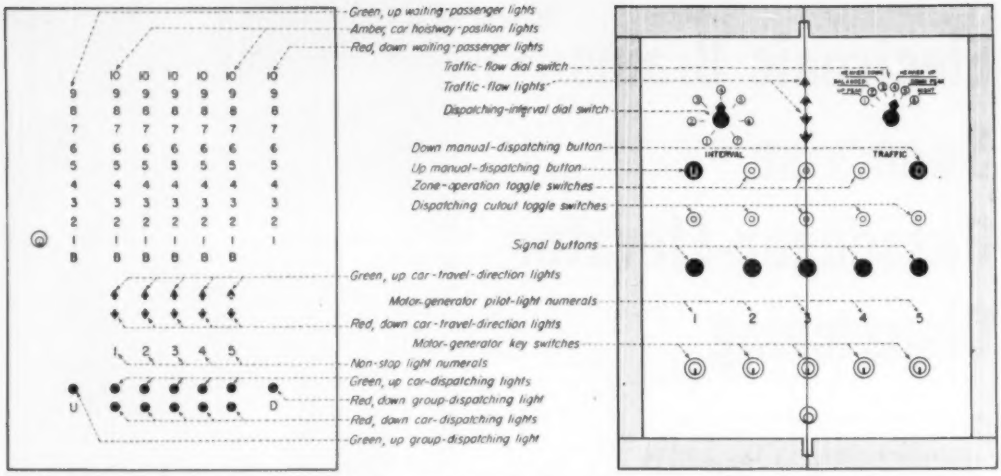
Between the *U* and *D* lights are two rows, top green for up direction, and bottom red for down. These are the car-dispatching lights. When one lights it indicates a corresponding car has been dispatched away from a terminal landing. If a green lamp lights, the car should start in the up direction, but when the red lights a car should start down.

The signal lights on this panel give the supervisor at all times a picture of where each car is, its direction of travel, how it is progressing toward a terminal landing, the floors where passengers are waiting, and other pertinent information. Knowing all this, what the supervisor needs is a means to convert this knowledge automatically into efficient elevator operation. This is done with the supervisor's control unit, Fig. 3.

Supervisory Unit. This unit is usually mounted below the indicator unit to form an indicator and control panel, Fig. 1. Switches on the supervisory unit are mounted on a panel tilted back and illuminated from above for the supervisor's convenience. Center-opening laminated-glass swing doors, with a magnetic catch, guard against unauthorized tampering.

Dispatching Interval. The dispatching-interval dial switch, shown enlarged in Fig. 5 *A*, sets the dispatching-time interval between cars signaled away from the terminal landings. When the switch is set on 1, a car is dispatched every 15 sec from the bottom or top landing. Setting the switch on 7 increases the time interval to 50 sec. Any interval between these two can be had by positioning the switch.

Traffic-Flow Switch. On the right-hand side of the panel, Fig. 3, is the traffic-flow dial switch, enlarged in Fig.



2 Supervisor's indicator is usually mounted above the control unit, as in Fig. 1, to form indicator-control panel

3 Control unit provides elevator supervisor with facilities for regulating elevator dispatching as the traffic changes

4. Each setting of this switch represents a specific program of operations, one program for each of the six types of traffic.

Moving the switch from one setting to another puts a new program into operation and cancels the previous one. Fig. 6 shows the six programs, their dial settings and conditions under which they are used.

Traffic-Flow Lights. Of the four traffic-flow lights, Fig. 5 *B*, two green arrows point up, and two red down, indicating which traffic program is operating. Lights are numbered in this article for easy identification. The ones that are lighted for the different services are indicated in Fig. 6. For example, during up-peak service, green lamp No. 2 lights, and for balanced service, green lamp 2 and red 3 light.

Dispatching Buttons. Manual dispatching buttons *U* and *D* are used to signal a car away from a terminal landing ahead of the automatic timing schedule. Pressing *U* button dispatches a waiting car from the ground floor. Pressing *D* button does the same for a waiting car at the top landing.

Zone toggle switches, one for each of the three cars that can operate in low-zone service, are used to transfer cars from low-zone to high-zone operation, or vice versa. When a switch for an elevator is in one position and the system is operating zone return, this car will serve low-zone traffic. When in the other position the elevator serves the high zone.

Cutout Switches. The dispatching cutout switches, a toggle switch for each car, are used mainly to take cars out or return them to service. But if passengers at the lower terminal landing enter a car, not scheduled for the next up signal, the supervisor may transfer the next up signal to this car. This is done by temporarily turning the cutout switch of the preceding car to the off position.

Signal Buttons. Below the cutout switches is a row of signal buttons, one for each elevator. These buttons sound a buzzer in a corresponding car for the supervisor to communicate directly with the operator, as by a signal code. When telephones are in the cars, the buttons can be used to tell the operator he is being called.

At the bottom of the panel is a row of motor-generator start-and-stop key switches. Above these are the motor-generator pilot-light numerals that show which of these units are running. Also, if a car is parked at the ground floor with its doors closed, turning its motor-generator switch to start opens the doors after the unit comes to speed.

Up-Peak Operation. Now that we have a general idea of the supervisory system, let's see how it handles elevator traffic. At the beginning of the morning up peak the supervisor sets the traffic-flow dial to *Up Peak*. Cars are then dispatched from the lower terminal only. They waste no time in useless travel to the top terminal. When they have answered the highest up call, they reverse automatically and return to the lobby.

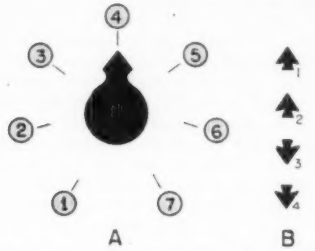
Car operators are generally instructed to leave the main floor when a car is 80% full. Thus, cars that fill quickly are not delayed. A car that loads slowly does not wait indefinitely for a full load. It is dispatched at a given time after the preceding one, provided another car is ready to load. If a car is not available, the partially loaded one is held for half an interval after its normal leaving time. Normally there is at least one car ready for passengers at the main landing.

Balanced Traffic. During balanced up-and-down traffic the chief problem is to keep the cars evenly distributed in the hoistways so all floors get regular service. For balanced-traffic operation the supervisor sets the traffic-flow dial to *Balanced* and the cars go into operation on this program. Cars are automatically dispatched from both terminal landings at regular intervals in the order they arrive. But a delayed car can be passed by others without upsetting schedules.

A delayed car is forced to make up lost time. It is reversed before it reaches the top landing, if there are no unanswered calls above. A car arriving late at the main landing may have its loading time reduced to keep it on schedule.

Bunching Prevented. If a surge of traffic occurs and a car is filled quickly at a terminal landing it can leave ahead of time when loaded. Another car is dispatched ahead of time from the other terminal landing to take its place. Also, if a car is delayed at one terminal beyond one-half interval, a car is held back at the other terminal. This prevents bunching the cars at terminals and helps keep them evenly spaced in the

4 Each setting on traffic-flow switch initiates elevator-operation program



5 *A:* Dispatching-time interval switch *B:* Elevator's traffic-flow lights

DIAL SETTING	TYPE OF TRAFFIC HANDLED	DIAL SETTING	TYPE OF TRAFFIC HANDLED
UP PEAK (1) Traffic-Flow Lamps Lighted	Heavy-up traffic from main floor with little or no interfloor or down traffic as during morning peak. No. 2 green	**HEAVIER UP (4)** Traffic-Flow Lamps Lighted	Heavy up traffic plus appreciable down traffic, as during the late noon peak. No. 1 and 2 green No. 3 red
BALANCED (2) Traffic-Flow Lamps Lighted	Traffic about equal in up and down directions. No. 2 green No. 3 red	**DOWN PEAK (5)** Traffic-Flow Lamps Lighted	Heavy down traffic with little or no interfloor or up traffic, as during the evening peak. No. 3 red
HEAVIER DOWN (3) Traffic-Flow Lamps Lighted	Heavy down traffic plus appreciable up traffic, as during the early noon peak. No. 2 green No. 3 and 4 red	**NIGHT (6)**	Light and intermittent traffic, as during nights, Sundays and Holidays.

6 Six elevator-operating programs obtained from settings of traffic-flow switch, Fig. 4, conditions for which the programs are used and the indicator lights

hoistway to keep service standards high.

Heavier-Down Program. During early noon, traffic is heavier down with considerable up traffic. This also occurs in most buildings, but to a less degree during the mid-morning and mid-afternoon "coffee periods."

Because down cars make more stops and handle more traffic during these periods, the down trip takes longer than the up. To take care of this condition the supervisor turns the traffic-flow switch to *Heavier Down*. The cars are then dispatched to have more serving down traffic than up.

Heavier-Up Traffic. Following the heavier-down peak there is a heavier-up peak to get people back to their floors. When this occurs the supervisor sets the traffic-flow dial switch on *Heavier Up*. Then cars are dispatched to keep an extra one in the up direction. When these peaks have passed, the supervisor sets the traffic-flow switch to *Balanced*, and cars are again dispatched to have an equal number going in both directions.

Down-Peak Traffic. During the evening down-peak, traffic accumulates at intermediate floors. To handle this condition the supervisor sets the traffic-flow switch to *Down Peak*. Cars are then dispatched from the top floor, or some floor near the top, on an electronically timed schedule. At the main landing, cars discharge their passengers and start back to the upper terminal. If there are no calls above a late car, it may be reversed before it reaches the top floor to serve the lower ones.

When traffic becomes very heavy, cars may be filled at the upper floors and bypass the lower ones. But lower-floor passengers do not have to wait indefinitely. Their total waiting time is added electronically and when it reaches a set limit the control does something to correct the condition.

If two or more lower-floor calls approach the time limit, the control system switches the cars to zone-return operation. With zone return the building is divided into a high and a low zone and the elevators into groups, one to serve each zone. Low- and high-zone cars reverse at highest call in their zones. To help low-zone cars care for low-zone congestion, unfilled high-zone cars answer low-zone calls until filled. When the peak has been cleared, the system switches over automatically to regular downpeak dispatching from the top landing.

Included in down-peak dispatching is what is called *Forgotten-Man Pickup*. Some times several cars may pass a lower-landing call and cause it to go unanswered for more than a normal period. To prevent this becoming serious, if any call goes unanswered for more than a minute, the system books this as a forgotten call. Then the first empty up car stops, picks up the waiting passenger and returns to the main floor landing.

Changing from down-peak dispatching to zone-return operation and back is done automatically by an electronic time totalizer. During down-peak operation each lower-floor down call is timed from when the corridor button is pressed until the call is answered. When the total call-seconds reach a set high, indicating that more service is required in the lower zone, operation swings over to zone-return control. When the call-seconds drops to a low set value the system changes over to time dispatching from the top terminal or near this terminal.

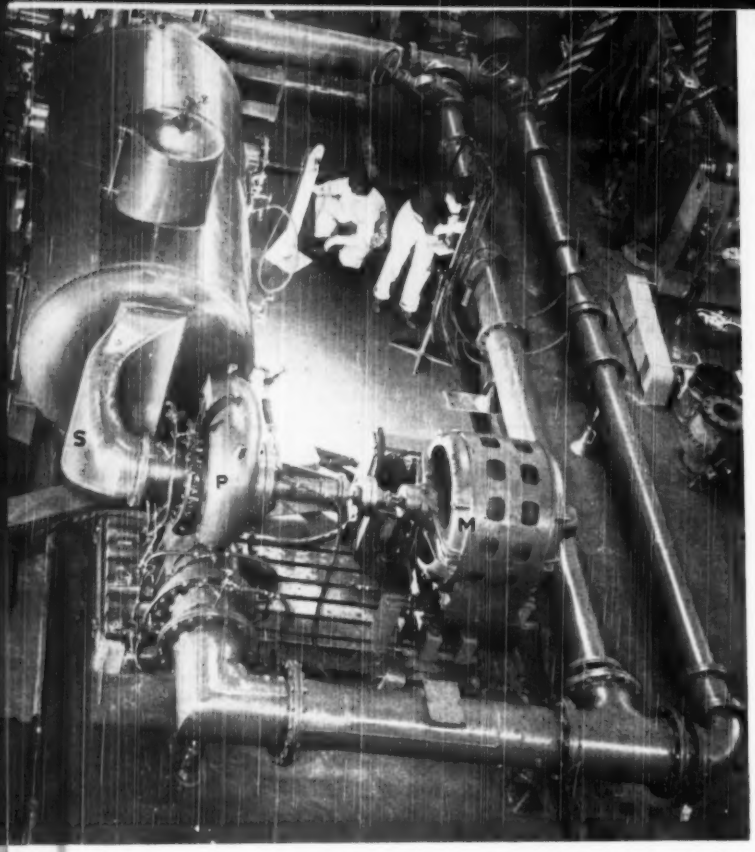
After the regular business-day traffic has been passed the traffic flow switch is turned to *Night* to provide an after-hour or holiday service consistent with the needs of the building. Night-service allows the cars to remain idle at the main landing when there are no calls to answer.

When a call is registered a buzzer sounds and a highest-call return light goes on. The attendant starts the car and it goes to the highest registered down call, answering up calls on the way up. At the highest call the car reverses and answers down calls on the way down.

For those buildings where a full-time night attendant is not required, one elevator can be equipped for automatic nonattendant night service control.

This feature allows the elevator to be switched over to self-service operation when the last attendant goes off duty. Untrained building employes and occasional tenants can then safely operate the elevator. Adequate all-night elevator service is provided without the expense of an all-night attendant.

There are many other features of this interesting control. But those covered give a general idea of how it watches the floor calls and takes care of them automatically.



1 Pump-turbine models on test. They consist of two identical units with draft tube. The one in the foreground operates as a motor-driven pump to supply water to second unit operating as a hydraulic turbine at the other end of the tank

Pump-Turbine Operates as Pump or Hydro Turbine

Pumped-storage hydroelectric plants use this unit with a single runner and casing in two ways: (1) motor-driven pump during off-peak periods to store water and (2) hydroturbine-driven generator to supply peak loads. Either operation is at good efficiency

► Between 1920 and 1934, over 1,500,000 hp of pumped-storage hydroelectric plants were installed, mostly in Europe, to supply peak loads on power systems (Power, 1934, p 18). Interest in these plants waned until now, when it is being renewed in this country. Earlier plants used separate pumps and turbines, whereas present research and engineering is directed toward a single unit to serve both as a pump and a hydraulic turbine.

Pump-Turbine Conference. About 50 water-power and other engineers were told and shown how this is being done at a conference on "Pumped-Storage Hydroelectric Power," held by Allis-Chalmers Mfg Co on June 1 in Milwaukee. This article is a summary of the papers presented by W W Weltmer, F E Jaski and W L Ringland with the company's research and engineering staffs.

About 20 years ago, research hydraulic engineers began to study what happened when power failed on a pump and the flow and pump reversed to operate as a hydraulic turbine. They found that a good pump running in reverse direction as a turbine had a respectable efficiency. This led to the development of a single unit instead of a separate pump and turbine for pumped-storage power projects.

Test on Models. Fig. 2 shows a cross section of the model units. It has a suction or discharge nozzle shaped like a draft tube, a medium specific speed runner, adjustable guide vanes and fixed stay vanes, as in a hydraulic turbine, and a volute casing. Its specific speed as a pump at design gate is 4230 on a basis of rpm, gpm and foot-head, or 199.5 on a basis of rpm, cfs and foot-head. As a turbine at the same gate, its specific speed is 51.8 on rpm, hp, foot-head basis. This unit represents what the designers think is a fair compromise of a pump-turbine for the conditions under which it is tested.

Two of these identical units have been built and are being tested, one as a pump, the other as a turbine in the same hydraulic circuit, Fig. 1. Pump *P* is driven by calibrated motor *M*. The pump's suction connection *S* to the tank is shaped like a draft tube. A pipe loop connects the pump's discharge to the inlet of the turbine's scroll case. This unit's output is measured by a hydraulic brake and is discharged to the tank through a draft tube of the same form and dimensions as the pump's suction connection.

Characteristic Curves. Fig. 3 shows combined characteristic curves of the pump-turbine. These curves are plotted by using the pump's capacity, head and brake horsepower at the design gate setting as 100% values. Dotted curves are for operation at 75% gate; dash-dot curves at 100% gate, and full curves 125% gate. At 100% pump capacity, horsepower input to the pump is 100%, point *A*; head is 100%, point *B*; efficiency 86.5%, point *C*. This is the 100% operating point for the pump.

If the head increased to 122 ft, by setting the gate to the 75% position, point *D*, an efficiency of 85%, point *E*, can be obtained at 80% capacity. Setting the gates at 125% opening for 122-ft head causes the pump's capacity to drop to 65%, point *F*, and the efficiency drops to less than 69%, point *G*.

Hydraulic-Turbine Operations. If we wanted 100% power from the turbine at 100% gate, point *H*, the head would have to be 130%, point *I*, and the efficiency would be 85%, point *J*. Turbine discharge under these conditions is 105% of pump's capacity when operating under 100% head, point *K*. This is about the best operating point. When the head drops to 100%, we can go to 125% gate, point *L*, and get about 80% power from the turbine, point *M*, with 105% discharge, point *K*, at 83% efficiency, point *N*. If we were to reduce the gate opening to 100%, point *O*, discharge would be reduced to 92.5%, point *P*, and the power to about 67%, point *Q*. But the efficiency would be only 82%, point *R*.

These illustrations show how the gates can control, to a degree, the characteristics of the unit as a pump and turbine. On a capacity basis, best efficiencies of pump and turbine are quite close together. This is one of the objects sought in the research on the pump-turbine.

Turbine and Pump Head. The head required by the turbine at a given gate is higher than that developed by the pump at the same gate. For example, at 100% capacity and gate the pump develops 100% head, point *B*. At the same gate and discharge the turbine requires 118% head, point *S*, to develop 85% power at an efficiency of 85% compared to 87% for the pump.

Flow Cycle. Let's consider some of the conditions under which a pump-turbine must operate. One of its purposes is to increase power capacity during peak loads. When driven in one direction by the electric-power unit operating as a motor it pumps water from a suction pool at a lower elevation and discharges to a storage reservoir at a higher elevation.

For generating power, the flow cycle is reversed and water flows from the storage reservoir through the pump-turbine and discharges to the suction pool. The same runner is used as a hydraulic turbine, and the motor running in the opposite direction becomes a generator.

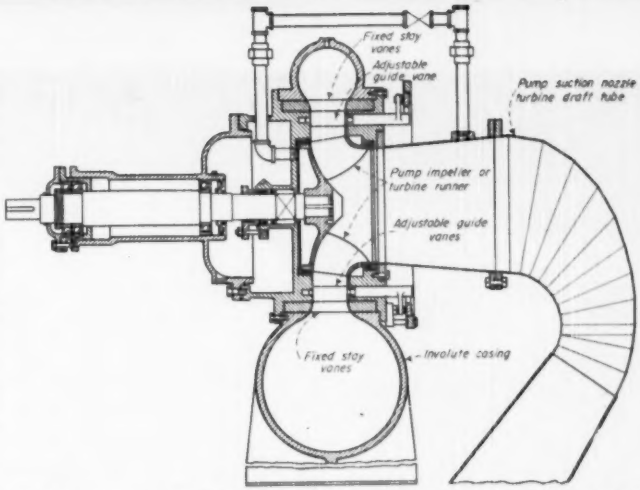
Total pumping head consists of the static head from suction-pool to storage-reservoir elevation, plus the friction loss in the system. At the start of the pumping cycle the suction pool is full and the storage reservoir is at its lowest level. So we start pumping against the lowest head and gradually increase to the highest, depending on the depth of the storage reservoir and the drawdown of the suction pool.

Net Head on Turbine. When generating power, the net head on the turbine is static, minus the friction loss in the system. We start with the highest head produced by a full storage reservoir and lowest level in the suction pool. Head then drops gradually to the minimum as the storage pond is drawn down and the suction pool fills.

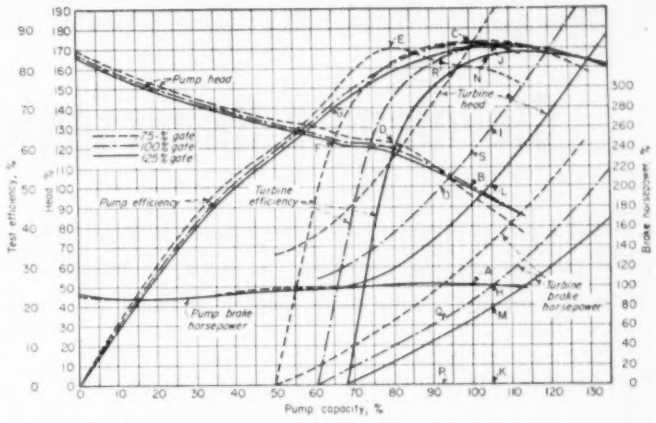
For a given static head when generating power, the runner may discharge more water per second than it will as a pump. The generating period in a 24-hr day may be 8 hr, during the greatest peak load. The corresponding pumping period may be 9 to 10 hr when off-peak power can be used. That is, the total water used during power generation may be pumped back into the storage reservoir during the pumping period.

Where Unit Is Used. It is assumed that the turbine-pump will be used on a fairly large system, which can supply power for pumping during off-peak periods so it can be had at a low cost per kilowatt-hour. Unit will be used to supply power during the peak loads, which can be sold at a much higher price per kilowatt-hour, and thus make it economical to install and operate.

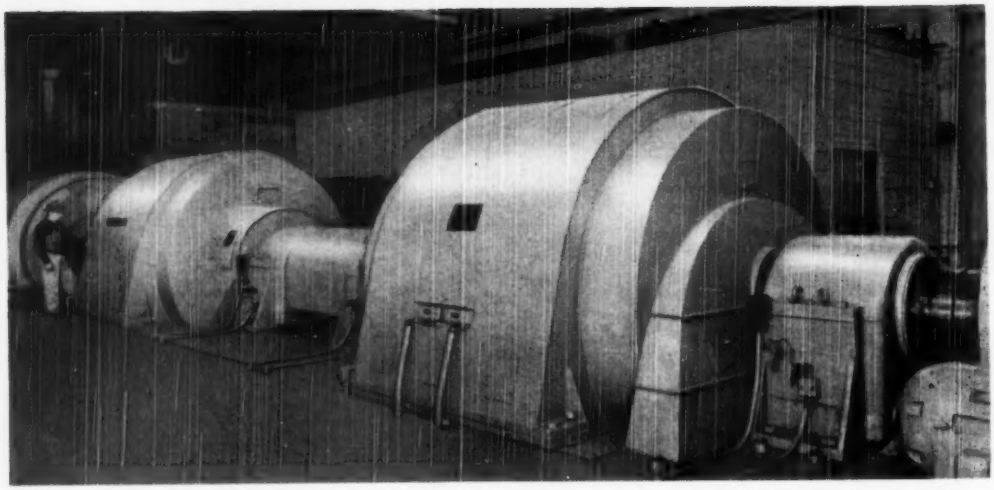
When generating, the unit should be loaded for operation at best efficiency, corresponding to changes in net head, to obtain the most kilowatt-hours. This means that the unit will not be used for taking load swings but to supply prime load on the system. This is opposite to the way pumped storage plants have operated in the past, but it reduces the cost of the unit and improves its operating efficiency.



2 Cross section through one of the pump-turbine models. It includes a suction nozzle or draft tube, a medium specific-speed runner, adjustable guide vanes around the runner, and fixed stay vanes outside of these—all in a volute casing



3 Combined characteristic curves of the pump-turbine models, one operating as a pump and the other as a hydraulic turbine. These curves are plotted by using pump's capacity, head and brake horsepower at design gate setting as 100% values



1 Three wound-rotor motors in tandem make up the required 87,000 hp. Speed control handled through liquid rheostats in the rotor circuit. Starting sequence of each motor is staggered to reduce sudden load on connected utility lines

Cleveland's Supersonic Wind-Tunnel

Critical design problem centered about keeping surges down on utility lines in starting, stopping. So three 29,000-hp motors were tapped on same shaft. External blowers cool them

By **C C CLYMER**, *Industrial Engrg Div*
W ALVAREZ, *Control Engrg Div*
D C HOFFMAN, *Panel & Equipt Div*
General Electric Company

► As the speed of aircraft slips beyond the speed of sound, new laboratory tools are needed for research at the higher speeds. Most formidable of these is the supersonic wind tunnel. It is interesting to note that, at supersonic speeds, power needs increase rapidly with speed. For instance, a tunnel with a test section eight feet in diameter operating at 700 mph (just under the speed of sound) needs about 16,000 hp. The same tunnel operating at a velocity around 1200 mph requires about 100,000 hp.

Power Needs. Power of this size means high pressures as well as high velocities. And this, in turn, means high speed in rotating apparatus. In the supersonic tunnel, air is supplied in proper quantity and pressure by an axial-flow compressor. This unit operates at 860 rpm and absorbs about 87,000 hp at this speed. Incidentally, the compressor was manufactured by the S Morgan Smith Co.

Compressor is driven electrically using purchased power. While an 87,000-hp motor could be supplied in a single unit, such a unit could not readily be started from any existing distribution system. We fully appreciated the critical problem of placing such a drive in operation.

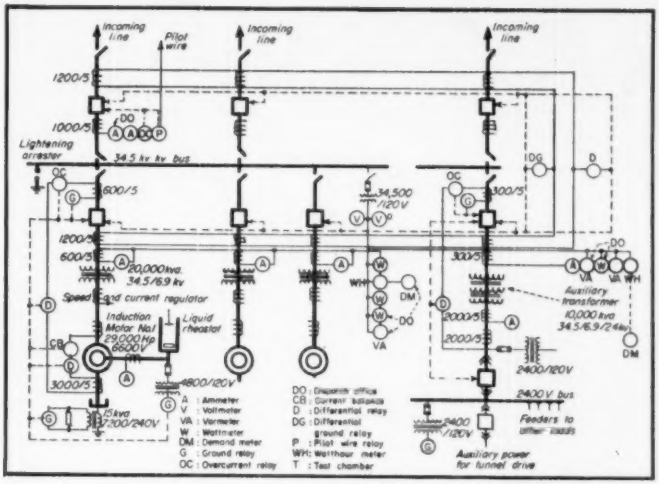
After considering all the factors involved, slipring motors were chosen to do the job. Economics, mechanical limitation, and starting conditions indicated the use of three duplicate motors, Fig. 1, connected in tandem mechanically, and in parallel electrically. Motors could thus be energized in sequence, reducing the momentary demand on the power system. This method also permitted a gradual load build-up so the power system would have time to become adjusted to the new requirements.

With subsonic tunnels, the air speed in the throat can be adjusted by controlling motor speed. For such tunnels an adjustable motor speed with at least a six-to-one range is used. And some such tunnel motors have gone as high as eighty-to-one. But the supersonic tunnel operates at relatively constant motor speed. Air speed is adjusted by changing the shape of the tunnel throat section.

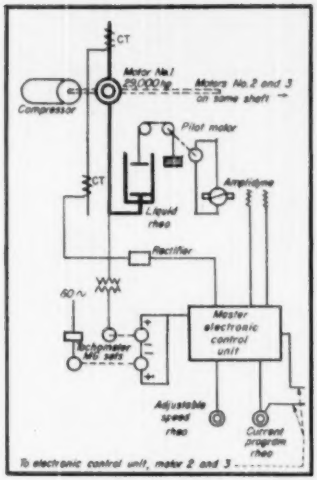
Motor Details. Motors for the supersonic wind tunnel even with an efficiency of 97%, have a loss of 2610 hp under normal operating conditions. This would prove an excessive heat load for any normal building. Hence the motors are totally enclosed, each with water-to-air heat exchangers. Exchangers are mounted in the motor pit together with an axial-flow blower (Buffalo Forge Co). These blowers deliver 70,000 cfm at 8 in. of water. This cooling arrangement reduces noise, keeps motors clean, and helps reduce building heating.

Bearings have flood lubrication and oil lift for starting. A preset amount of oil is delivered to each bearing. One motor is equipped with a turning gear so the shaft can be turned at 2 rpm for inspection and maintenance.

Because of mechanical-design limitations, motor stators are wound for 6600 v. This results in currents that are too



2 Emergency connection can be made between third feeder (right) and 34.5-kv motor bus. Dotted lines join motor relays and the circuit breakers they will operate



3 Motor speed controlled by difference in voltage of tachometer generators

Boasts 87,000-Hp Motor

high for switching. So each motor is connected solidly to a 3-phase transformer. The motor-transformer combination is switched as a unit, Fig. 2.

Liquid Rheostats. Liquid rheostats have been used for many years as a power-absorbing device, or as the adjustable external-resistance element for a wound rotor. Design of the liquid rheostats for our 87,000-hp motor drive presented certain novel problems. Notable amongst these were: (1) unusual heat rejection, particularly during acceleration of the drive (2) electrode insulation introduced by the relatively high ring-to-ring voltage (3) high speed-control accuracy.

Fig. 4 shows the liquid rheostat for one of the three drive motors. Movable electrodes are connected together mechanically and electrically to form the neutral of external rotor circuit. Hoist mechanism, which positions the movable electrodes, is operated by a reversing dc pilot motor.

Several important features of the liquid rheostat are:

1. Each phase has a separate tank and cell assembly, insulated from ground and from adjacent phases by porcelain insulators. This is necessary to relieve cell and electrode insulation stresses. It also simplifies handling.

We might add that the liquid rheostat has come far since the "salt box" design was first used. Modern units have wide application for acceleration and speed control of polyphase wound-rotor induction motors. These rheostats are notable for their stepless-speed control with minimum maintenance, maximum dependability. Besides supersonic wind-tunnel drives, among those applications depending on the liquid rheostat for speed control are centrifugal fan and pump loads, and steel-mill roll drives.

2. Size of drive motors relative to power-system capacity dictated that the initial inrush for each motor be limited to about 15,000 kva. Consequently, the rheostat design was set to give 200% rotor circuit ohms with the electrodes at maximum stroke of 5 ft, 6 in., and electrolyte at 65 C.

3. Motors are started in sequence since starting all three simultaneously would impose a 45,000-kva inrush. Timing sequence is adjustable; ultimate adjustment rests with user and power supplier.

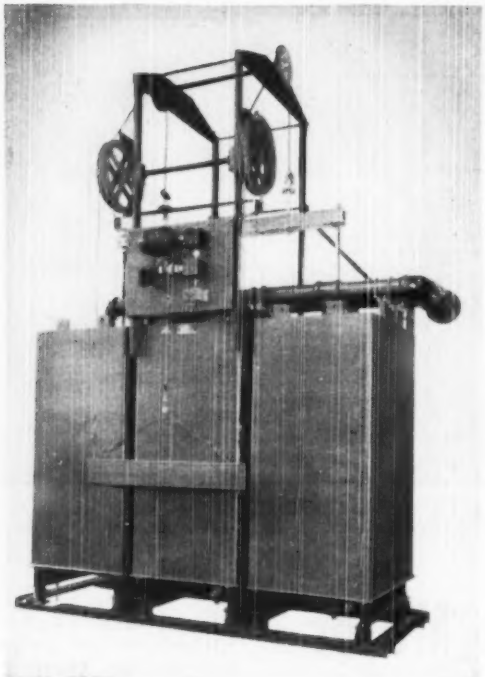
Speed Regulation. Drive speed is checked by two dc tachometer generators. One generator is driven at constant speed by a synchronous motor from the 60-cycle supply. The other is driven at a speed directly proportional to the slip frequency of drive motor No. 1. Both tachometer generators are connected in series with voltages opposing. Resultant of the two voltages is directly proportional to drive speed of motor.

Liquid rheostat position for motor No. 1 is controlled from the master electronic-amplidyne control unit. This master-control unit includes two input members, the speed-control rheostat and the current program rheostat. Both establish definite operating characteristics during acceleration and shutdown and during normal operation of the drive.

Electronic-control units for the liquid rheostats of motors No. 2 and No. 3 operate as "follower" control units, and dictate the performance of No. 2 and 3 to correspond to performance of motor No. 1.

Automatic Switchgear. Drive motors are controlled from the main control board in the motor room. This board consists of stationary front and rear panels and end enclosures with hinged doors and top plates, all bolted together to form a rigid self-supporting structure. Instruments, control switches, annunciator, and sequence relays are mounted on the front panels. Protective relays and other sequence relays are mounted on the rear panels.

The one-line diagram, Fig. 2, shows in simplified form the basic power circuits, protective relays, instruments and meters for the main drive motors, transformers, and incoming lines. While complete circuits are shown for only one incoming line and one drive motor, the equipment is the same for all three lines and all three motors. Motor 6600-v stator windings connect directly to the secondary windings of 20,000-kva transformers. Primary windings of these



4 Liquid rheostat for varying resistance in the secondary of 29,000-hp induction motor. Unit is amplidyne controlled

transformers connect to the 34.5-kv outdoor switchyard bus through oil circuit breakers.

This bus is normally supplied by two incoming lines from a 132/34.5-kv substation a short distance away. In an emergency, power can be supplied by a third line from another substation Power source in either case is the public utility 132-kv distribution system in and around Cleveland. A 10,000-kva transformer supplies auxiliary power at 2400 v for the drive. Its chief purpose, however, is to supply loads in other areas at 2400 and 6900 v.

In an installation of this size, many conditions must be checked before the motors can start safely. Starting and stopping the drive includes many steps that must be performed in correct sequence and at proper time intervals. So completely automatic control was provided for all starting, stopping and protective functions. Indications to start and stop the drive are normally given by a master control switch on the duplex control board in the motor room.

Chief problem in designing the control was to avoid sudden large changes in power taken from the source. Since 87,000 hp is a large block of power to be picked up or dropped by a public utility system (even for a city the size of Cleveland) the control had to be designed to avoid tripping off the motors suddenly except in case of extreme emergency. As will be detailed later, the protective devices are grouped so they are selective regarding the manner in which the drive is shut down under abnormal conditions.

Master starting circuit includes contacts of protective relays and other devices to check that normal conditions exist before the starting sequence can begin. This circuit also includes a control switch at the dispatch office and on a control panel at the tunnel. If normal conditions exist and the switches at the dispatch office and tunnel are in the run position, the operator in the motor room may start the drive by flipping the master control switch. The sequence thereafter is entirely automatic.

Automatic Stopping. In the usual automatic-control equipment, stopping the controlled machine is merely a matter of tripping all circuit breakers and dropping out the controlling relays. In this equipment, however, the automatic-stopping sequence is as important and as involved as the starting sequence because of the requirement that the normal load of 87,000 hp must not be dropped suddenly unless absolutely necessary.

In general, the normal stopping sequence is just the reverse of the starting sequence. When the indication to stop the drive is given by the master-control switch or by the stopping switches at the dispatch office and tunnel-control panels, the sequence takes place automatically.

Protective Operation. Complete protection against abnormal conditions is provided. Need for avoiding sudden reductions in load on the power system requires that the shutting-down sequence be varied according to seriousness of the trouble. To obtain such selectivity, the protective devices are divided into four groups according to the nature of the fault. One group sounds an alarm and operates an annunciator without causing a shutdown. The other three groups shut down the drive in a sequence such that the rate of load reduction is not greater than necessary to minimize damage due to the abnormal condition.

Testing Switchgear. Only way the drive can be started is by the automatic starting sequence described. But provision is made for checking the sequence and protective devices, and for operating the switchgear and auxiliaries individually without energizing the motors. A control transfer switch can swap all the control circuits over to individual control switches or pushbuttons. When this switch is in the *manual* position, each circuit breaker, magnetic starter, and motor-operated rheostat may be operated independently by its own pushbutton or control switch. When the switch is in the *test* position, equipment can be made to run through the entire automatic starting and stopping sequence, the same as when the drive is in operation. Only exception is that the motors are not energized since the line disconnecting switches are open.

Control-transfer switch has a magnetic lock to prevent it being moved from the *automatic* position while the equipment is in operation. Or, for that matter, while the motor line's disconnecting switches are closed. This magnetic lock is released and the switch may be moved either to the *manual* or *test* positions when conditions warrant. Even so, test sequence cannot be started unless the disconnecting switches are in the open position.

To check operation of the electronic regulators during the *test* sequence, an artificial indication of drive speed is obtained from a hand-operated potentiometer connected across the control-battery bus. Battery potential is used instead of the voltage obtained normally from the two dc tachometer generators.

1 Full face of gear shows cutting tool at beginning of cut. This gear, weighing 380,000 lb, had its teeth recut in place. It is one of eleven in a train that drives a 96-in. plate mill at Carnegie-Illinois Steel's South Chicago Works

GIANT GEAR RECUT IN PLACE

By **E C DENNE**, *Manager, Gear Department*
United Engineering and Foundry Co

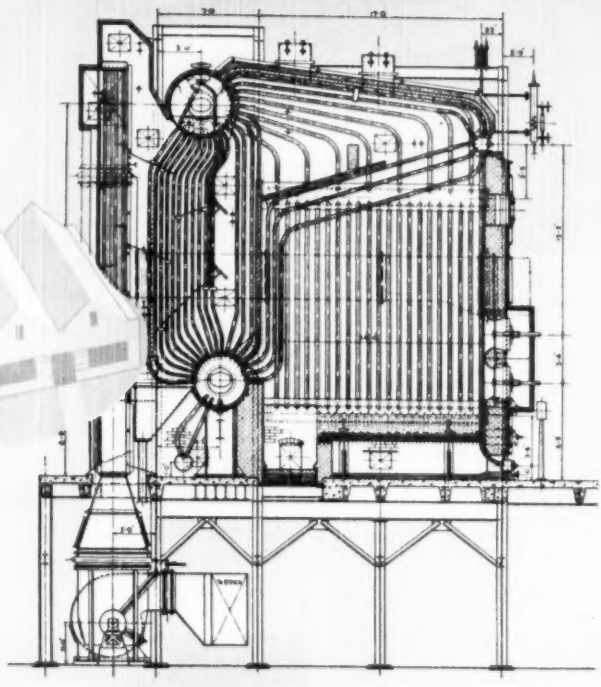
► WHEN A 380,000-lb gear needs its tooth stagger corrected, a lot of engineering planning and ingenuity must be used to do the job in the shortest time and at lowest cost. This was the problem the engineers of Carnegie-Illinois Steel Corp faced on the 96-in. plate mill at the Corporation's South Chicago Works. It was not practicable to remove the gear for recutting so United Engineering and Foundry Co, Pittsburgh, Pa., reconditioned it in place.

This gear is one of eleven in a drive 94.5 ft long and about 24 ft wide, Fig. 5, p 108. Gear train is driven by a 6000-hp 365-rpm motor, with a large flywheel mounted each side of the motor pinions. As shown on the drawing, three mills are driven from the gear train. Gear to be reconditioned has a pitch-diameter of 21 ft 4 in. a 6-ft-2-in. face; its circular pitch is 6.20 in. To reduce handling and shipping problems, the gear, designed to transmit about 20,000 hp at 10.1 rpm, was made in five sections.

Continued on page 108

2 Milling head just after the start of the new cut on the gear, which has a pitch diameter of 21 ft, 4 in., and face width of 6 ft, 2 in. with 128 teeth staggered

In the South..... Smokestacks are growing—



75,000 lbs./hr. Riley Steam Generating Unit
Masonite Corporation, Laurel, Miss.

Masonite started to use Riley boilers in 1939. Since that time Masonite has placed six different orders with Riley for seven Riley boilers with a steam capacity of 415,000 lbs. Mr. E. C. Grady, Plant Engineer, will gladly tell you of their experience with Riley boilers.

You Can Rely on Riley

When you select Riley Steam Generating or Fuel Burning Equipment, you can count on efficient trouble-free, thoroughly satisfactory performance because of excellent design and quality workmanship and because of Riley's extensive engineering experience. Riley's rapid growth has resulted from the outstanding performance of their equipment. Every user of Riley equipment will assure you, "you can rely on Riley."

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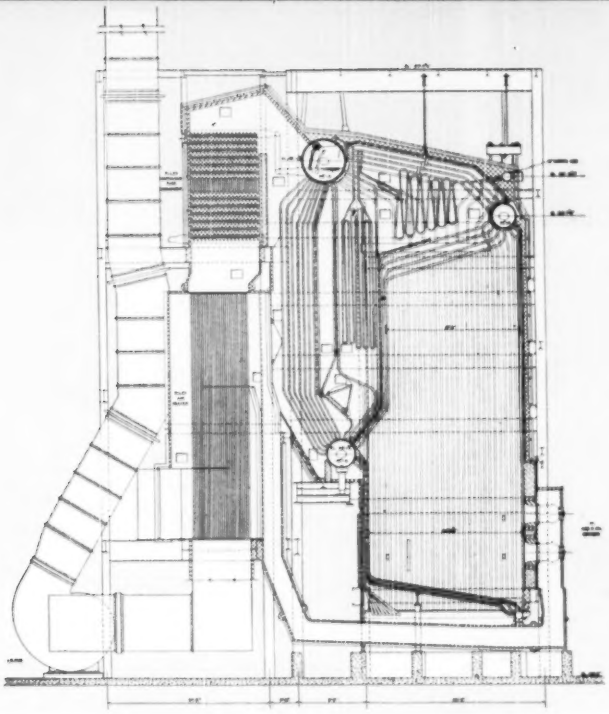
and you will find Riley Steam Generating Units under many of the recent ones!



Houston Lighting and Power Company, one of the largest Southern Public Utility companies is another good Riley customer. Since 1938 Houston has ordered only Riley boilers — 8 different orders for 9 large Riley Steam Generating Units — having a steam capacity of over four and a half million pounds of steam an hour. Conclusive evidence of the complete satisfaction obtained with Riley equipment.

All these well-known Southern plants use **RILEY** *boilers*

Southern Industrial Plants

Dow Chemical Co., Freeport, Texas
Gaylord Container Corp., Bogalusa, La.
Champion Paper & Fibre Co., Canton, N. C.
Savannah Sugar Refining Co., Savannah, Ga.
Crown Cork & Seal Co., Baltimore, Md.
Godchaux Sugars, Reserve, La.
Southern Alkali Corp., Corpus Christi, Texas
Mead Corp., Sylvia, N. C.
Celanese Corporation of America, Narrows, Va.
Celanese Corporation of America, Bishop, Texas
Celanese Corporation of America, Rock Hill, S. C.
Celanese Corporation of America, Hopewell, Va.
Celanese Corporation of America, Cumberland, Md.
Ecusta Paper Co., Pisgah Forest, N. C.
Masonite Corporation, Laurel, Miss.
Commercial Solvents Corp., Sterlington, La.
Riegel Textile Corp., Ware Shoals, S. C.
Calco Chemical Co., Piney River, Va.
International Harvester Co., Louisville, Ky.
Humble Oil & Refining Co., Baytown, Texas
Congoleum Nairn Co., Cedarhurst, Md.
Mathieson Alkali Co., Lake Charles, La.
Revere Copper & Brass Co., Baltimore, Md.
Standard Oil Co. of La., Sterlington, La.
Lone Star Steel Co., Daingerfield, Texas
Park & Tilford, Inc., Midway, Ky.
Alamo Refining Co., Sweeny, Texas
Republic Creosoting Co., Norfolk, Va.
U.S. Gypsum Co., Plasterco, Va.
Brown & Williamson Tobacco Co., Petersburg, Va

Southern Public Utility Plants

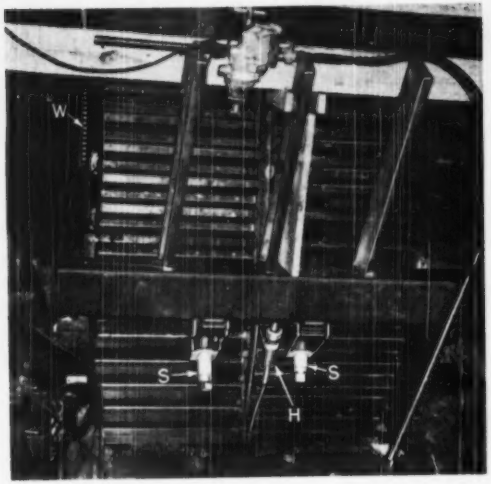
South Carolina Power Co., Charleston, S. C.
Mississippi Power Co., Hattiesburg, Miss.
Arkansas Power & Light Co., Little Rock, Ark.
New Orleans Public Service Co., New Orleans, La.
Northern Virginia Power Co., Winchester, Va.
Gulf Power Co., Pensacola, Fla.
Florida Power & Light Co., Lauderdale, Fla.
Carolina Power & Light Co., Moncure, N. C.
Southwestern Public Service Co., Borger, Texas
Houston Lighting & Power Co., Houston, Texas

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

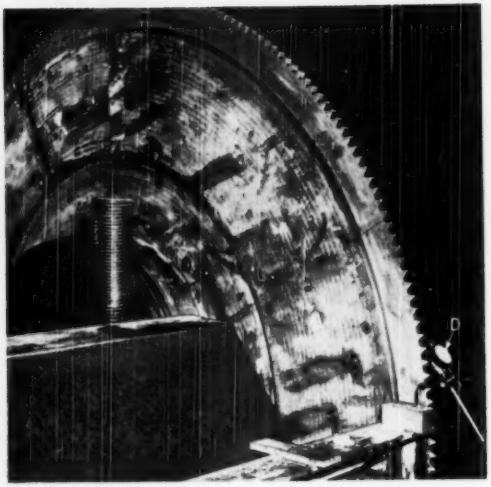
COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

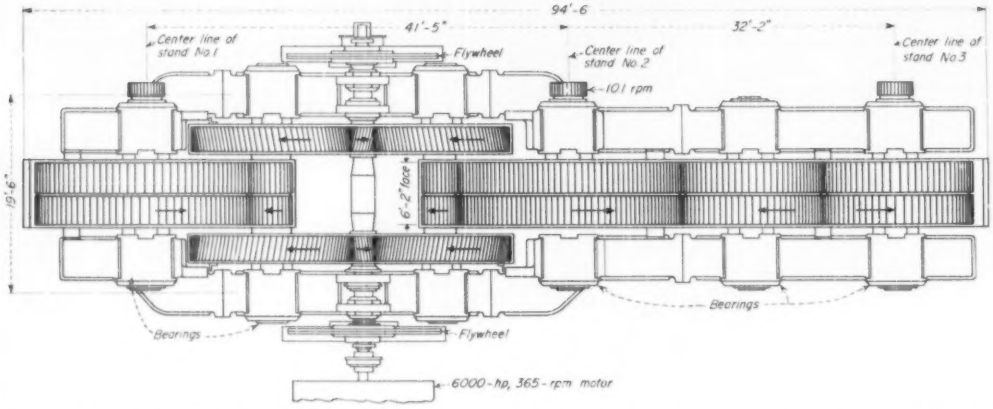
ECONOMIZERS · WATER-COOLED FURNACES · STEEL-CLAD INSULATED SETTINGS · AIR HEATERS



3 The heavy gear was rotated tooth by tooth by hydraulic jack *H* and held by setscrew *S* when cutting each tooth



4 Dial indicator *D* in combination with the index wheel gave an accurate check on the gear-tooth spacing and stagger



5 This gear train, made up of eleven gears, forms a drive 94.5 ft long by about 24 ft wide. It is driven by 6000-hp 365-rpm motor with a large flywheel located on each side of the motor pinions. Three mills are driven by these gears

In cooperation with Carnegie-Illinois engineers, several schemes were proposed for conditioning the gear. Because of its size and weight we decided to recut it in place. If we had not done this, it would have had to be dismantled and shipped to our shop. There it would have been assembled, the teeth recut, dismantled, shipped to site and assembled in the drive. This job would have required three months, compared to 14 days in which the work was completed.

Gear-cutting equipment designed and built by us was shipped to the site, and assembled for installation when the job was started on August 28. In spite of the gear cutting being somewhat unusual, the work progressed much better than we expected. It was completed and steel-rolling started on Sept 11.

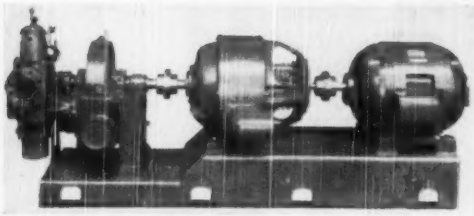
Photos show how the work was done. the large indexing wheel, Fig. 4, is 10 ft in diameter, has 256 teeth, twice as many as in the large gear. This number permitted indexing each tooth and the opposite stagger tooth to keep the cutting error within practical limits.

Dial indicator *D* mounted on the right in combination with the index wheel gave an accurate check on tooth spacing and stagger. Experience, of course, was necessary to set the dial indicator correctly and allow for grinding the milling cutter. The heavy gear was rotated tooth by tooth by hydraulic jack *H* and held in position by setscrews *S*, Fig. 3, during cutting of each tooth. The index wheel is seen at *W*.

Considering that only one cut could be made because of the time required, it is a miracle that errors were kept within practical limits. After ten days of steel rolling, the gear cover was removed to inspect the teeth. They showed 100% contact across their face for the entire circumference of the gear. The job was well done.

LETTERS FROM A TURBINE SPECIALIST—13

By C A LILLY, Jr and H A MAYOR, *Turbine Divisions, General Electric Co.*



STEAM TURBINE, *left, drives exciter, center, at lower speed if motor drive, right, should fail because of lack of power*

Dual Drives Supply Reliable Service by Automatic Operation

Turbine Specialist
District Office

Dear Mr Specialist

In looking over the proposal you submitted for a turbine-generator, I see you recommend a combination turbine and motor drive for the separately driven exciter. I want the maximum reliability obtainable for this set. Your proposal appears to be a good arrangement.

Please give me an explanation of just how this drive operates. Once I am certain of the details, I may use a similar arrangement for our boiler-feed pump drives.

Yours very truly
ENGINEER

Dear Mr Engineer

A turbine and motor combination driving the exciter in your power plant will give excellent reliability. This "dual drive" arrangement has proved itself in many applications on boiler feed pumps, fan drives and exciter sets.

In an actual application the turbine, motor and exciter shafts couple together so they all rotate at the same speed. Under normal conditions the motor drives the exciter and also the turbine. At this speed the turbine governor does not admit any steam to the nozzles to carry load.

When the motor's power supply fails for any reason, the shaft speed drops, causing the turbine governor to act and open the admission valves feeding steam to the nozzles. This enables the turbine to pick up the load and the unit continues to run and deliver exciter power.

The new speed with the turbine carrying the exciter load is somewhat below the motor full-load speed. In normal applications this is about 5% lower than the full-load motor speed. This causes the exciter voltage to drop about 5% also.

Turbine design would be based on its ability to carry full exciter load and the motor drag at this reduced speed.

When power is restored to the motor circuit there is an excess of shaft power available, with both turbine and motor supplying driving torque. This increases speed, and the motor instantly assumes the exciter load. The turbine through its speed-governor setting automatically gives up the load. This restores the set to normal operation.

Exchange of load is entirely automatic and needs no service of an attendant. All steam lines must be properly trapped and drained to prevent water accumulating in them.

Remember, rotation losses and bearing friction losses of the turbine have to be added to the exciter rating to determine the motor capacity. Turbine losses average about 1 to 2% of full-load rating.

Operation of the dual drive set on your boiler feed pumps should be the same as in the above description. Throttling control on the pump discharge normally used on an application of a motor-driven feed pump would still apply.

To have sufficient capacity in the pumps, however, the over-all design requires a slight modification. This enables developing rated capacity at reduced speed when driven by the turbine. Slightly greater throttling on the pump discharge is needed when the motor is carrying the load. This should not affect over-all design, and it would give you the added reliability desired.

The dual-drive units offer the additional feature of supplying "makeup" steam for heat-balance needs in your plant. For example, exhaust steam from the turbine can be used for processing needs or for building heating during peak steam-demand periods.

During normal steam-demand conditions, motors would carry the exciter or pump load and turbines would be on standby service.

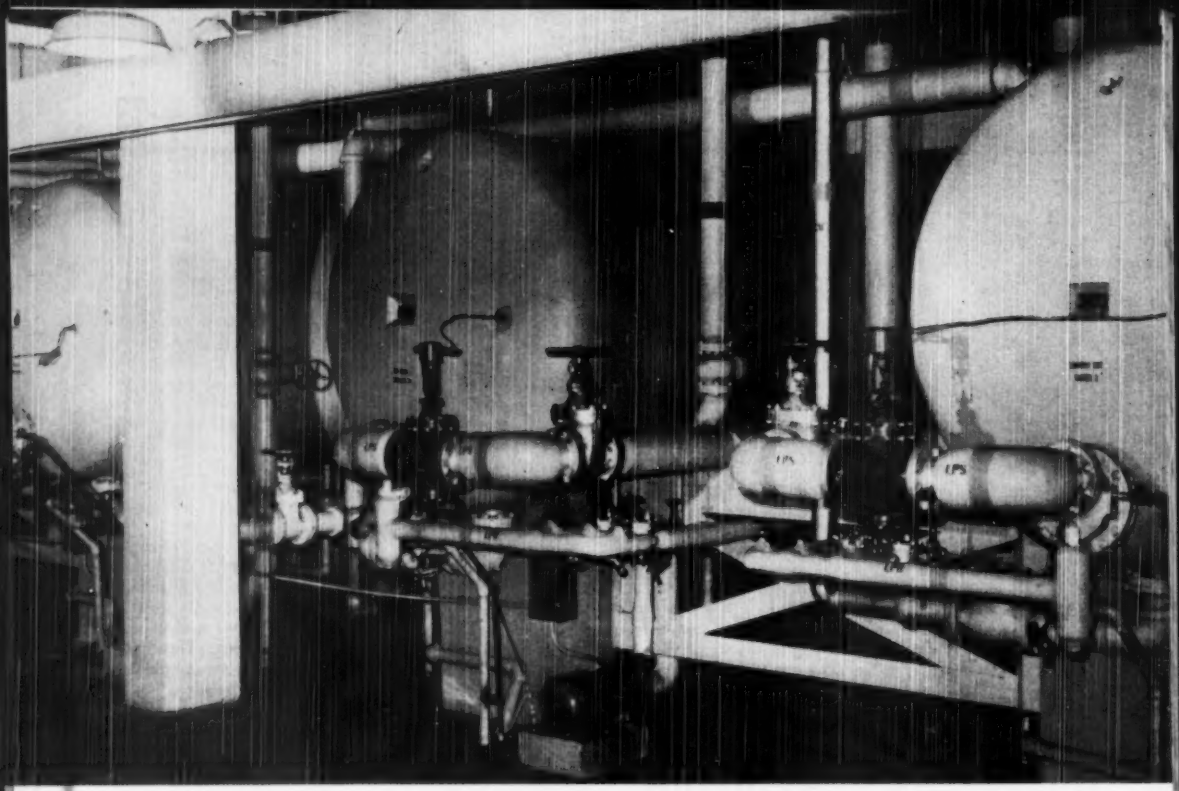
By studying your heat-balance requirements, an operation schedule can be set up to give you the best utilization of this feature. This would be a bonus on the basic need for reliability in emergencies.

If you want further information on dual drives and their control, I will be more than glad to go over the subject with you during my next visit.

Sincerely yours
TURBINE SPECIALIST

NEW LONG-DISTANCE GAS LINE PROPOSED

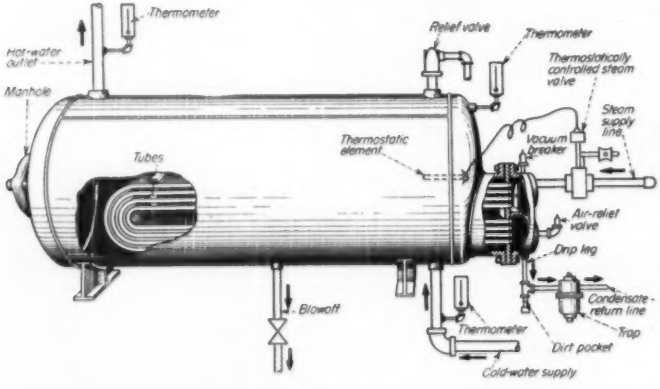
Pacific Northwest Pipeline Corp has applied to the Federal Power Commission for authorization to build a 2175-mile pipeline system. This would bring natural gas from southern Texas to the Pacific Northwest. The $174,000,000 system would tie in with the Alberta, Canada, gas fields to supply areas in Tacoma-Seattle, Wash., Portland, Ore., Vancouver, Canada, Spokane, Wash., Salt Lake City, Utah, and Boise, Twin Falls, Pocatello, in the state of Idaho.



STORAGE-TYPE, indirect hot-water heaters in Shamrock Hotel, Houston. Each of the three heaters has a storage capacity of 1400 gal. Two units on the left serve guest rooms in the 18-story building. Heater on right is for hotel laundry

Better Hot-Water Setup for Your Plant

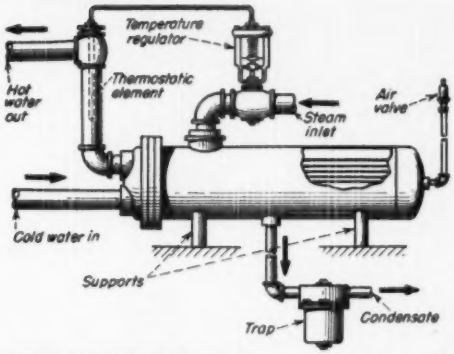
It's the power engineer who always catches it when hot water is too hot or too cold. To do the job well in a large or small plant, tailor your heater, piping and controls by these practical methods



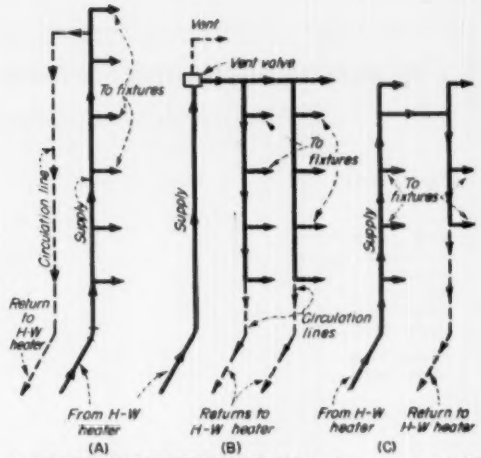
1 INDIRECT STORAGE HEATER using steam as heating medium. Piping arrangement shown is that most commonly used. Tank can be copper-lined for corrosive water

► HOT-WATER TEMPERATURE can be kept right—if equipment for the job is correctly selected and applied. Let's look at typical hot-water systems and see what makes them tick.

Water Heaters. There are several ways of heating water for plant-production areas, cafeterias, washrooms and other places. Water temperature can



2 **SHELL-AND-TUBE TYPE** instantaneous heater and connected piping. Good for constant steam supply and water demand



3 **HOT-WATER PIPING SYSTEMS:** (A) single-riser up feed. (B) down feed: several risers. (C) combined up and down feed

be increased by burning fuel under a tank or coil, by a "carrier" such as steam or hot water, or by electrically heated surfaces. Where steam supply is limited, or electricity cheap, electrical heaters are sometimes used. Steam and hot water are the commonest carriers for heating hot water in modern buildings. So we'll take a good look at heaters using these carriers.

Now for a few definitions. In a *direct* heater, heat from a fuel like coal, gas or oil increases water temperature. *Indirect* heaters use steam or hot-water carriers. These heaters may be either the storage or the instantaneous type, Fig. 1 and 2.

Storage Heaters. In this type, Fig. 1, heating medium passes through U or straight tubes, heating the water around them. A circulation is set up in the tank. This tank is large and may hold enough water to meet, or nearly meet, maximum demand on heater.

In general, the less uniform the demand for hot water, the greater the storage capacity needed. With a large storage capacity and non-uniform demand, heating-coil capacity can be less because time available for heating between peak loads is greater. When demand is fairly uniform, storage capacity can be less, but heating-coil capacity must be greater. To keep heating coil and load on boiler small, large storage capacity is used wherever possible.

Industrial, office and school building demands are usually non-uniform, peak loads occurring during very short periods. Loads in hotels, apartment houses and hospitals are usually more uniform.

Instantaneous Heaters. In this type, Fig. 2, water to be heated flows through straight or U-shaped tubes. It picks up heat from the heating medium around the tubes—either steam or hot water for indirect heaters. Water is heated as needed; there is no storage section. Heater coils may be installed in a boiler instead of a tank.

Load and Capacity. Hot-water heater size depends on maximum amount of hot water needed during any one hour, total quantity of water to be heated per day, and duration of peak load on heater. Domestic water demand can be based on average number of people in building or number of plumbing fixtures installed. In our example we'll use the "fixture method" though the "person method" is just as accurate.

Example. An industrial plant has these fixtures installed for personnel: 9 showers, 200 private lavatories, 20 slop sinks, 20 public lavatories, and 1 dishwasher. What is hourly water consumption, and storage and heating capacity needed if process water is heated separately?

First we figure hourly water quantities using data from Table I (next page):

9 showers at 225 gph	2025 gph
200 private lavatories at 2 gph	400
20 slop sinks at 20 gph	400
20 public lavatories at 12 gph	240
1 dishwasher at 250 gph	250
Total hourly demand	3315 gph

This total demand is based on continuous operation of all fixtures. Since such a condition seldom occurs, we can apply a demand factor to find *maximum probable demand*. Using the factor from Table I, maximum probable demand = 0.40 (3315) = 1326 gph. Heating-coil capacity must at least equal maximum probable demand. Storage capacity, also obtained by use of a factor, should be 1.00 (3315) = 3315 gal.

If an instantaneous heater were used for this job, we'd select a unit suitable for heating 3315 gph through the desired temperature range. Sufficient capacity to meet the maximum demand is necessary because instantaneous heaters do not have any storage capacity. Hence, you'll usually find them applied to fixed-demand loads.

Heaters supplied with steam from a heating boiler increase heating load by about 4 sq ft edr per gal of water heated through 100 F. Heaters using low pressure steam need about 1 lb of steam per gal of water heated through 100 F.

Piping. Either an up-feed or a down-feed system can supply hot water to domestic and industrial fixtures. To provide hot water continuously at each fixture, circulating piping, Fig. 3, is often employed. Water not used is returned through this piping to the hot-water heater. Here its temperature is increased to needed value and the water returned to the supply system.

Where circulation piping run is long or where building is high, a circulation pump may be installed to ensure positive movement of the water. Pump is controlled by a thermostat installed in the return line. Thermostat is usually set to start and stop pump after a 20-F change in water temperature.

Run-outs from return risers should be fitted with a check valve to prevent temporary flow reversal if a faucet's open. Valve fitted in return line permits circulation control through system.

Air that accumulates in your piping

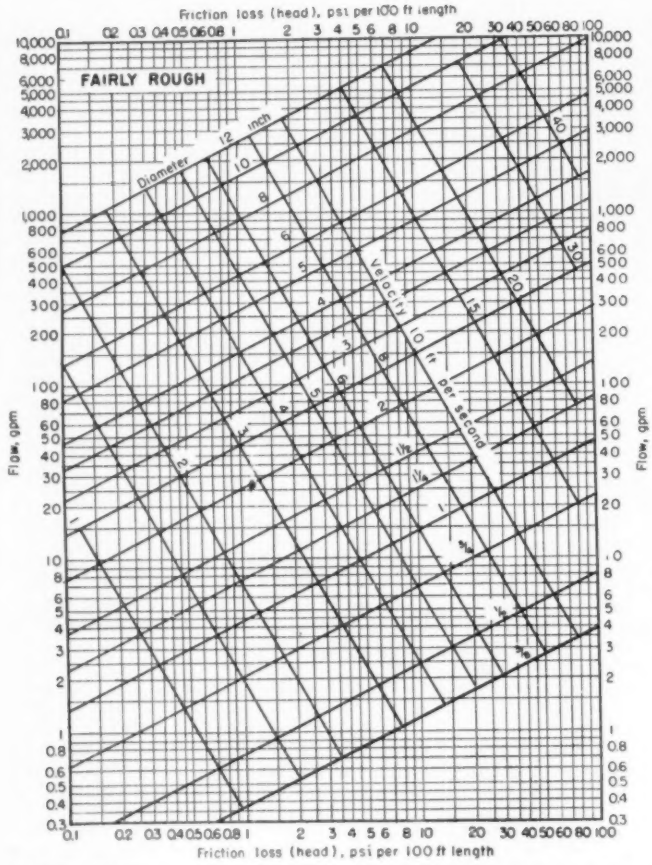
I: HOT-WATER DEMAND PER FIXTURE FOR VARIOUS BUILDING TYPES

Based on Average Conditions for Types of Buildings Listed
Gallons of Water per Hour per Fixture at 140 F

Type of Fixture	Apartment house	Hospital	Hotel	Industrial plant	Office building
Basins, private lavatories	2	2	2	2	2
Basins, public lavatories	4	6	8	12	6
Showers	75	75	75	225	—
Slop sinks	20	20	30	20	15
Dishwashers (per 500 people)	250	250	250	250	250
Pantry sinks	5	10	10	—	—
Demand factor	0.30	0.25	0.25	0.40	0.30
Storage factor	1.25	0.60	0.80	1.00	2.00

II: HOT-WATER TEMPERATURES FOR VARIOUS SERVICES

Cafeterias (serving areas)	130 F
Lavatories and showers	130 F
Slop sinks (floor cleaning)	150 F
Slop sinks (other cleaning)	130 F
Cafeteria kitchens	130 F + steam



4 FLOW CHART for *fairly rough* pipe. To use, enter at flow on left or right and project horizontally to pipe size. Read pressure loss at top or bottom. Water velocity is read on the curves sloping from upper left to lower right. Chart is suitable for finding pressure losses in both hot- and cold-water piping systems

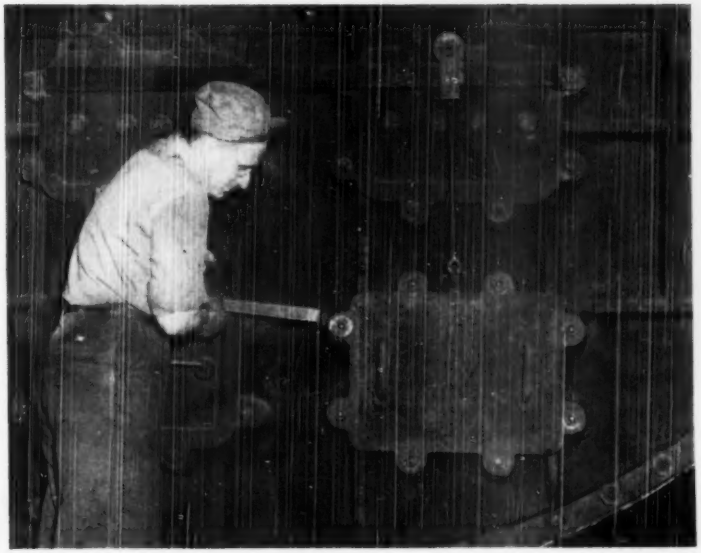
must be removed to prevent sputtering at fixtures every time they are used. In up-feed and combined up and down-feed systems, Fig. 3 *A* and *C*, circulation piping is connected to the supply main just below highest fixtures in system. Air, which usually accumulates at high point in system, is released every time top fixture is used. In down-feed systems, Fig. 3 *B*, and those where overhead supply main is above highest fixture, an automatic float-actuated air vent is generally used to rid system of air.

Pipe Sizes. Undersize supply and return piping can ruin your hot-water system quicker than anything else. Where ferrous pipe is used in supply and return lines, it is usually considered to be *fairly rough* for figuring friction losses. With such an assumption, your friction losses will not be excessive after corrosion and caking of the internal wall have begun. When water is known to be extremely corrosive or badly caking, pipe should be assumed as *rough* when sizing.

Fig. 4 is a flow chart for fairly rough pipe. Charts for rough pipe and copper tubing (considered smooth) are similar. Suppose we used a 1¼-in. main to supply hot water to the plant in the example. From Fig. 4 we find pressure loss to be 8 psi per 100 ft for a flow of 1326/60, or about 22.1 gpm. Velocity is 6 ft per sec. This is about right, 3 to 8 ft per sec being the velocity commonly used.

Pressure loss in a hot-water supply system is sum of loss in pipe and fittings, heater and water meter. Minimum pressure allowable at highest fixture in building is usually taken as 8 psi. So allowable loss between main and highest fixture is main pressure minus 8 psi.

Temperature Control. As you see



Trolley Increases Safety and Saves Labor

New York City Transit System received the National Safety Council's "Distinguished Service to Safety" award this May. In building up their safety program they found that every time work was made less hazardous it also became easier.

Take condenser doors. They are usually heavy, slippery, and must be handled in cramped and hot spaces. The work is hard and is rushed by most operators. Accidents result.

NYC Transit found that hernias, injured legs and feet were often caused by poor handling of condenser doors. Here's how they tackled this problem, making work safer and easier.

Only lower doors are opened for tube inspection. To save lifting, a trolley was made of flat bar, a roller and rod. Bar is bolted across the upper doors. Rod fitted with roller has an eye at its lower end, which passes through a similar eye screwed into condenser door.

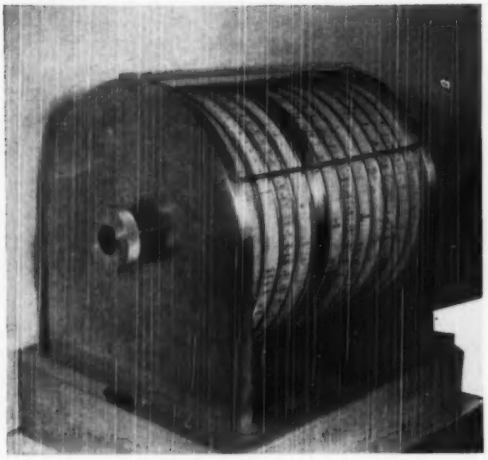
Nuts are removed from door and it is swung away from the bolts. Supported by rod, door is rolled to one side. After inspection of condenser, door is rolled back and bolted in place.

Trolley like this can be made from scrap parts at low cost. Upper door handles may have to be cut off to make room for trolley. At NYC Transit plants, removal of upper doors for inspection has been found unnecessary.

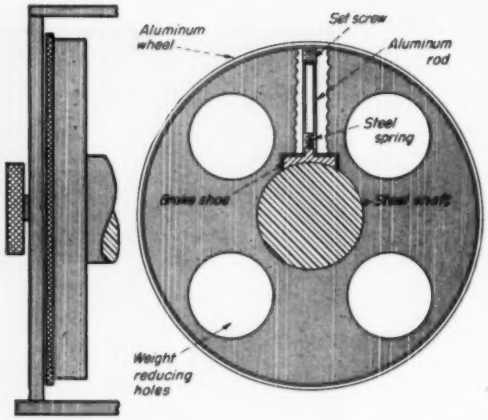
from Table II, required temperature of hot water varies with the service. Values listed are common for industrial plants but local conditions may require slight variations. Where large quantities of hot water are needed, it is common practice to use separate heaters for domestic and process water.

A thermostatically actuated valve controls steam flow to indirect storage heaters and instantaneous heaters of the types in Fig. 1 and 2. Thermostat projects into tank or outlet pipe. Control valve is generally fitted with a bypass and strainer. Thermometers on inlet and outlet of heater permit you to check cleanliness and water temperature at any time. Air-relief valve and vacuum breaker allow outflow and inflow of air, as necessary.

Other Heater Types. In small industrial and residential plants, indirect heaters consisting of a separate heating coil and storage tank are sometimes used. Heating coil is mounted either inside boiler or in a cast-iron shell close to boiler. Water from boiler passes over the coil and heats the water inside. Heated water then goes to the storage tank where it remains until needed. You figure load and capacity of these units in same way as above. Circulation piping is sometimes omitted from these systems if distance between heater and fixtures is small. Heat losses from piping are thereby reduced.



1 Computer consists of 12 disks, mounted on shaft, carrying incremental rate strips. Brace, at front, acts as index



2 Detail of single disk shows setscrew for adjusting brake friction on shaft. Disks rotate independently or together

Computer Matches Incremental Rates

By L J PARSONS AND C MARTENS, *System Engineering Department, Consolidated Edison Company of New York, Inc*

► THE INCREMENTAL-RATE METHOD of load division for a central-generating system produces optimum fuel economy at all load levels. To apply this method the incremental heat rates of the equipment in operation must be known over the load range. On a system-wide basis the load dispatcher assigns loads on the basis of station incremental heat rates. Station incremental rates in turn depend on the combination of boilers and turbines in operation.

Whenever boilers and turbines are put in service or taken off the line, the station incremental-rate-vs-load curve changes. This immediately affects the system load division. A station with 20 boilers that can feed any of five turbines can have about 100,000 possible combinations of equipment with corresponding incremental-rate curves. If there are several stations on a system, the possible combinations of equipment become enormous. This mathematical possibility ordinarily will never be realized in practice, but actual combinations needed will run into the thousands.

We find it doesn't pay to compute the incremental-rate curve for a combination until it's needed. This holds down the number of curves and tables on file and avoids unnecessary work. We do need, however, a quick method of figuring station incremental rates, one that avoids the tedious plotting of equipment curves as followed in the basic method.

To speed up this job we developed the cylindrical computer, Fig. 1. It has several rotating wheels on a common shaft. They can all be rolled together as a unit by turning the knurled knob and adjusting their brakes, Fig. 2, to a rubbing fit on the shaft. They also can be turned independently of each other by the knurled rims. Only four of the wheels are needed to compute a station incremental-heat-rate curve or strip. The computer can also be used by the load dispatcher for system load division by placing his logarithmic station incremental-rate strips on the drums*. The computer can accommodate 10 stations. Corrections can be made for varying fuel-price differentials between stations and other factors.

Station Incremental Rates. In this rapid method, station incremental heat rates are calculated from the incremental rates of boilers, turbines and electrical auxiliaries. The basic equation is,

$$R_{st} = \frac{R_t R_b}{1 - R_a}$$

where R_{st} = station incremental heat rate, Btu per kwhr
R_t = turbine incremental heat rate, Btu per kwhr
R_b = boiler incremental heat rate, Btu input per Btu output
R_a = auxiliary incremental rate, ratio of increment aux kw to increment kw load

The computer does not multiply out this equation, but it matches the quantities for each load level. This can be done rapidly. Equation solution can be carried out by conventional slide rule or computing machine in a matter of seconds by listing quantities as shown in Table I, p 117.

Turbine Strips. Let's see how the turbine strips are made. They are graduated rules or scales with turbine incremental heat rates, plotted against a length measured in terms of turbine heat input which equals boiler heat output in Btu per hr. Fig. 3 shows how they are derived. In basic method, you

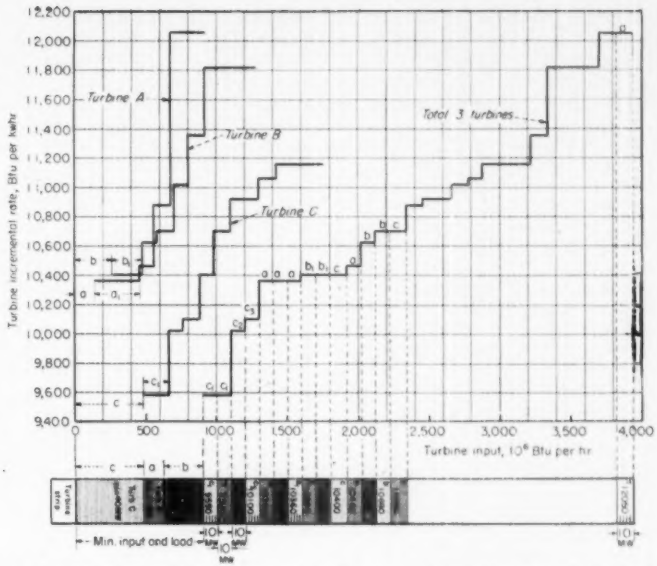
*See *Economy Loading of Power Plants and Electric Systems*, by M J Steinberg and T H Smith, John Wiley and Sons.

To run a power system economically the load should be divided by the incremental-rate method among the units. Here's a simple machine to speed up figuring station incremental rates which vary with combination of units on the line. This eliminates figuring rates in advance of actual need, avoids keeping bulky file of station data. Clerical personnel can be easily trained to operate it

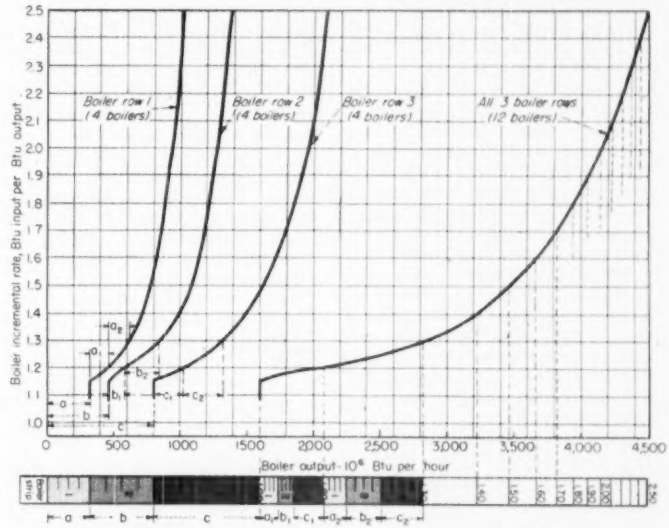
may recall that turbine incremental rates are plotted against kw output. Here they are plotted against Btu-per-hr turbine input instead. The familiar stepped-shape curve appears on this plot. Note that the curves are marked off in 10-mw steps as shown by the letters, c_1, c_2, c_3, a_1, b_1, etc, on the curve for three turbines.

The total curve is figured from the three individual turbine curves, in the usual fashion, by adding the individual turbine inputs cumulatively at each incremental rate level. The total curve is then transposed to the turbine strip shown below. Principal graduations are marked off at 10-mw intervals noting the corresponding turbine picking up that increment of load and the incremental heat rate at which it produces the added output. These graduations are automatically proportioned to the magnitude of turbine total input. Since this station has no steam-driven auxiliaries, the turbine heat input equals the boiler heat output.

Note that the left end of the strip is marked off with the minimum load that can be carried by each turbine. These in turn are plotted at the corresponding heat input values. The order in which these minimum loads are marked off is optional.

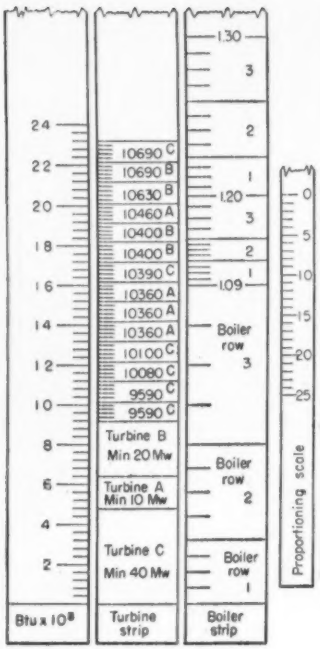


3 For computer, turbine incremental heat rates are plotted against turbine heat input, transferred to strips with each block representing 10-mw increment load

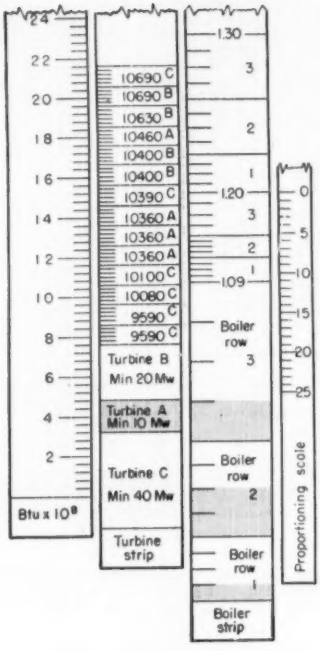

Boiler incremental rate, Btu input per Btu output
Boiler row 1 (4 boilers)
Boiler row 2 (4 boilers)
Boiler row 3 (4 boilers)
All 3 boiler rows (12 boilers)
Boiler output-10⁶ Btu per hour

4 Boiler incremental rates plotted against heat output are transferred to strip at each even value. Blocks are subdivided in ratio of load carried by boilers

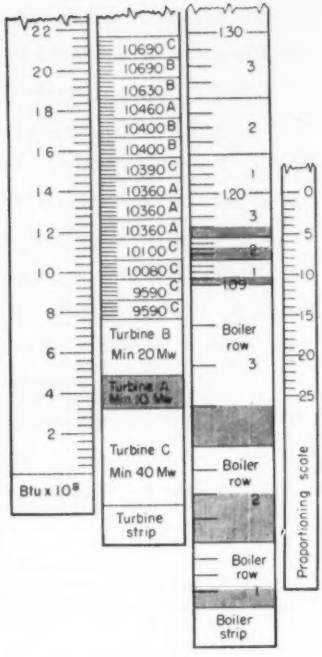
Boiler Strips. Fig. 4 shows the incremental-rate plot of three boiler rows, each row having four identical boilers, and the combined curve for all 12 boilers. The boiler strip below is marked off to correspond to even values of incremental rate for the total curves. These correspond to Btu boiler output or turbine input. Now, we must divide each of these incremental rate steps to represent the proportion produced by each boiler. We assume that the incremental rate curves are made up of straight lines between even values of increment rate levels. This introduces an entirely negligible error in the calculations. Comparing the letters a_1, a_2, b_1, b_2, c_1, c_2, etc, Fig. 4 shows how these steps are proportioned among the rows. Each of these divisions is then equally divided into four parts to represent the indi-



5 Strips line up this way when all turbines and boilers are in operation



6 Shaded areas show equipment out of service eliminated from figuring rates



7 Upper boiler-strip shaded areas show adjustment for out-of-service boilers

vidual boilers in each of the three rows.

Like the turbine strip, the left end of the boiler strip is marked off for the minimum boiler loads. The letters *a*, *b* and *c* show how this is set up and proportioned by rows. Each of these major graduations is in turn divided into four equal parts, one for each boiler.

Setting Up Computer. All that's needed for each station is a boiler and turbine strip. These must include all units in the station. These strips need only be set up once. They will need revision whenever the performance of any of the units changes, which will occur infrequently.

Fig. 1 shows how these strips are set up in the computer. Clips on the drum hold the strips in place. Fig. 5 shows how they will look when lined up on zero boiler heat output. Left-hand scale is both the boiler output and turbine input in Btu per hr, against which the strips are originally plotted. Right-hand scale is an interpolating scale for calculating boiler increment rate. As set up in the calculator, these scales can be moved in respect to each other or can all be moved together past the index line by turning the shaft.

Fig. 5 shows the proper positioning of the first three scales in relation to each other when all boilers and turbines are in service. In this case, we can see that the minimum boiler load controls the minimum amount of load the station must have to stay on the line. This occurs at 16×10^8 boiler output where the boiler increment rate is 1.09. The index line is not drawn in the figure but this can be checked by laying a straightedge across the figure.

Let's find the kw load the station must have for this condition. We do this by adding up the minimum loads on the turbine strip and then adding 10 mw for each block. This figures out to be $40+10+20+(6\times10)+8 = 138$ mw. The turbine increment rate for the last block of 8 mw is 10,360 Btu per kwhr. The auxiliary power increment rate for this station is constant over the load range at 0.034 kw per kw ouput. Then station increment rate is:

$$R_{st} = \frac{10{,}360 \times 1.09}{1\text{-}0.034}$$

or, 11,700 Btu per kwhr at minimum station load of 138 mw.

We customarily load our stations to even blocks of 10 mw. So let's figure 140 to 150 mw as the next load block. First we'll set the proportioning scale zero opposite the second step on the boiler strip at 1.20. We then read 11.3 on the proportioning scale opposite 1.09 on the boiler strip. This value will help us quickly interpolate the intermediate boiler incremental rates.

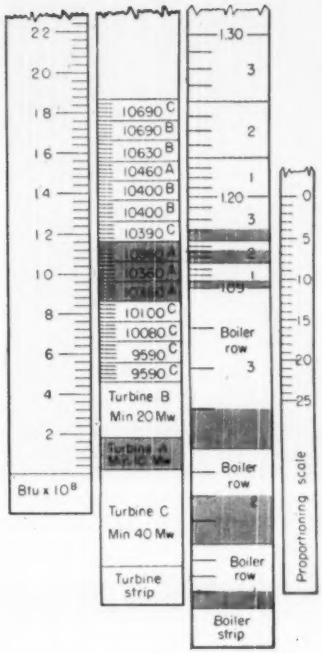
At the 140 to 150 mw block read 10,390 on the turbine strip. We use the boiler increment rate at 145 mw for this block. At this load the proportioning scale reads 9.7. Then the boiler increment rate can be figured by interpolation: $1.20-(1.20-1.09)\ (9.7/11.3) = 1.106$. This looks involved when written out this way. Actually, most of it is done mentally with the fraction figured by slide rule or calculating machine. Over most of the load range the boiler incremental differential is exactly 0.1 and the denominator of the fraction stays constant over quite a few 10-mw load blocks. So these values can really be found quickly. Then the average station incremental rate for the 140 to 150 mw block, or at 145 mw, is,

$$R_{st} = \frac{10{,}390 \times 1.106}{1\text{-}0.034} =$$

11,900 Btu per kwhr

For the next block we find the station incremental rate at 155 mw. Reading Fig. 5, we find the turbine incremental rate is 10,400 Btu per kwhr. The proportioning scale reads 7. Then the boiler incremental rate is figured as:

$1.20-(1.20-1.09)\ \ (7/11.3) = 1.132$.



8 Upper shaded area on turbine strip shows adjustment for unavailable unit

From which incremental station rate is:

$$R_{st} = \frac{10{,}400 \times 1.132}{1 - 0.034} =$$

12,190 Btu per kwhr

And so we proceed up the load scales. When we pass the increment boiler rate of 1.20, we set the proportioning scale zero opposite the 1.3 and find the intermediate values between 1.3 and 1.2, for the boiler incremental rate, as above.

Unavailable Units. The most usual case, of course, is to have some of the units out of service. We then have to handle the computer somewhat differently. Suppose the equipment in service is turbines *B* and C, three 1st-row, two 2nd-row and three 3rd-row boilers. The following moves illustrate how the out-of-service equipment is eliminated from the calculations.

The Btu scale at left in Fig. 6 serves as the reference point. Here the scales are in position for minimum load with the specified equipment in service. This is how we move them from the position in Fig. 5. We first rotate the entire group by the shaft till the bottom of the minimum block for turbine *A* is on the index line. We then move the turbine strip only, downward, till the top of this block is on the index. We then have eliminated this block from our figuring. The scales show the total minimum input to turbines *B* and *C* to be 7.6×10^8 Btu per hr.

We make a similar series of moves to eliminate the boilers out of service. The entire drum is moved till the index lines up with the bottom of the boiler strip, which will be opposite O Btu as in Fig. 5. We then move the boiler strip, only, down one division to eliminate one boiler in the 1st row. Next rotate the entire drum until the index lines up with the bottom of the Row 2 block. Then move the boiler strip only, a second time, downward two divisions to eliminate the two boilers out of service in Row 2. Now, rotate the entire drum again to line the index with the bottom of the Row 3 block. Finally, move the boiler strip only, downward one division, to eliminate the one 3rd-row boiler. We end up with the strips shown in the position of Fig. 6. Minimum output of the specified boilers in service at an incremental rate of 1.09 is 10.7×10^8 Btu per hr. The corresponding turbine output = 40 + 20 + (3x10) + 1 = 91 mw. Station incremental rate will then be figured from the 10,100 turbine incremental rate and the 1.09 boiler rate, for 91 mw load.

Note that the last block of 10-mw load was picked up by turbine *C*. Now, let's figure the increment rate for the block 91 to 100 mw. For convenience we'll figure it at 95 mw load, which has an increment rate of 10,100 Btu for the turbines. We then have to find the boiler increment rate, which lies between the values of 1.20 and 1.09. To do this the respective boilers out of service must be eliminated from the setting of the strips.

We follow the same procedure as before, roll the entire drum to line up 1.09 on the boiler strip with the index. Then move the boiler strip only, one division downward to remove one 1st-row boiler. Next, roll the entire drum downward until the bottom of the 2nd-row block lines up with the index. Then move the boiler strip only, downward two divisions to eliminate two boilers. Again roll the entire drum downward until the bottom of the 3rd-row block lines up with the index. Finally, move the boiler strip, only, down one division, removing one boiler from that row. Then move the proportioning scale zero opposite 1.20, and we have the scales in the positions shown in Fig. 7.

To calculate the boiler increment rate at 95 mw, rotate the entire drum to line up the 91 mw graduation on the turbine strip with the index. Now, you remember that at 91 mw the boiler increment rate is 1.09. The proportioning scale reads 7.9 at the index. This value is denominator of the interpolating fraction for boiler incremental rates between 1.09 and 1.20.

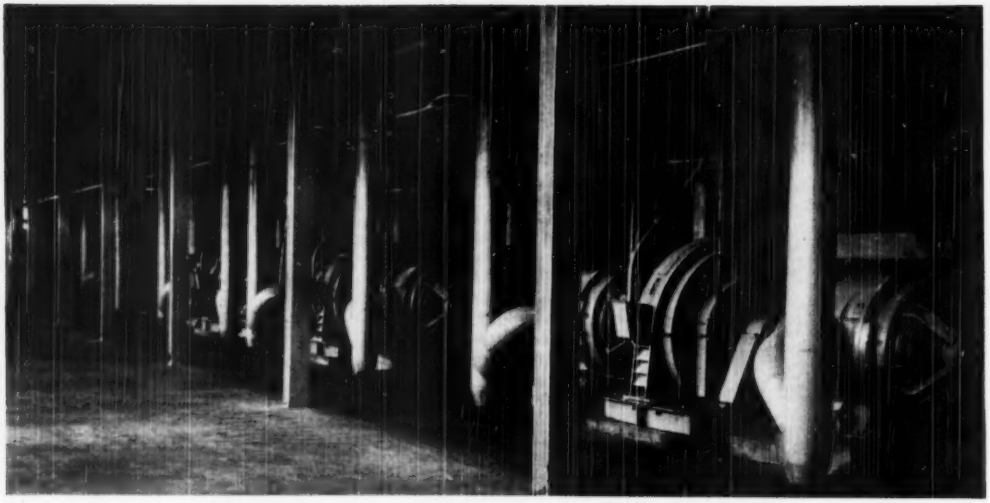
To get the actual values at 95 mw, rotate the drum to line up the index

(*Continued on page 202*)

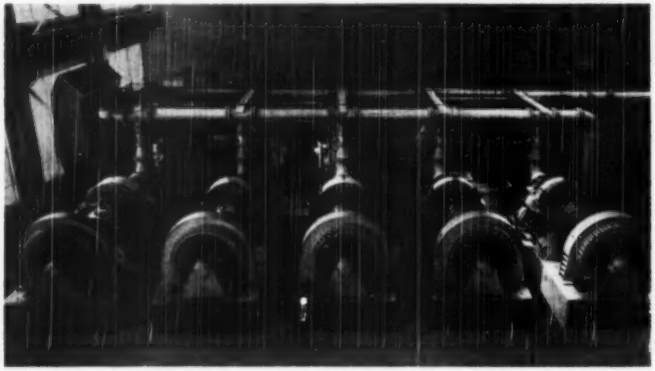
TABLE I—CALCULATION OF STATION INCREMENTAL RATES

EQUIPMENT IN SERVICE: 3 FIRST-ROW BOILERS; 2 SECOND-ROW BOILERS; 3 THIRD-ROW BOILERS; TURBINES B AND C
ELECTRICAL AUXILIARY INCREMENT RATE IS 0.034

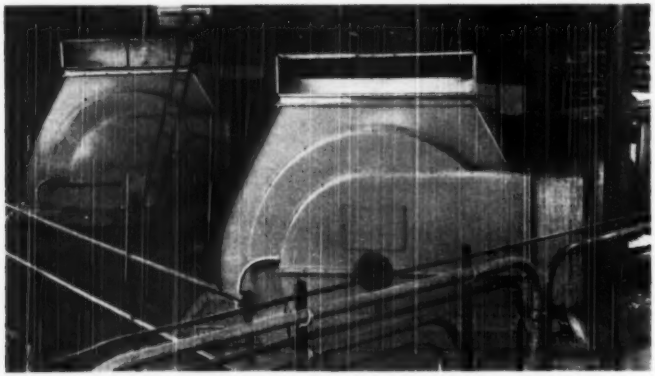
Turb-gen loads, mw			Turbine inputs 10^8 Btu per hr			Incremental rates			
B	*C*	Total	*B*	*C*	Total	R_t	R_b	$\frac{1}{1-R_x}$	R_{st}
20	40	60	265	485	750	—	—	—	—
20	50	70	265	580	845	9,590	1.090	1.035	10,820
20	60	80	265	675	940	9,590	1.090	1.035	10,820
20	70	90	265	775	1040	10,080	1.090	1.035	11,370
20	80	100	265	880	1145	10,100	1.165	1.035	12,180
20	90	110	265	980	1245	10,390	1.182	1.035	12,760
30	90	120	370	980	1350	10,400	1.200	1.035	12,920
40	90	130	475	980	1455	10,400	1.214	1.035	13,070
50	90	140	580	980	1560	10,630	1.228	1.035	13,510
60	90	150	685	980	1665	10,690	1.249	1.035	13,820
60	100	160	685	1090	1775	10,710	1.265	1.035	14,020
60	110	170	685	1200	1885	10,930	1.300	1.035	14,710
60	120	180	685	1305	1990	10,930	1.330	1.035	15,050
70	120	190	795	1305	2100	11,010	1.375	1.035	15,670
70	130	200	795	1420	2215	11,070	1.426	1.035	16,340
70	140	210	795	1530	2325	11,170	1.485	1.035	17,170
70	150	220	795	1640	2435	11,170	1.575	1.035	18,210
70	160	230	795	1755	2550	11,170	1.685	1.035	19,480



1 Synchronous motors like these driving vacuum pumps are used wherever possible because they return two benefits—a highly efficient drive along with a leading reactive kva that helps to boost the power factor of mill-supply system



3 Constant speed of synchronous motor drives despite any swing in voltage or load results in a high-quality stock output from a battery of twelve refiner units



4 Rotor element of synchronous motors driving these Carthage chippers connects directly to the chipper to provide full power to chipper-disk without slippage

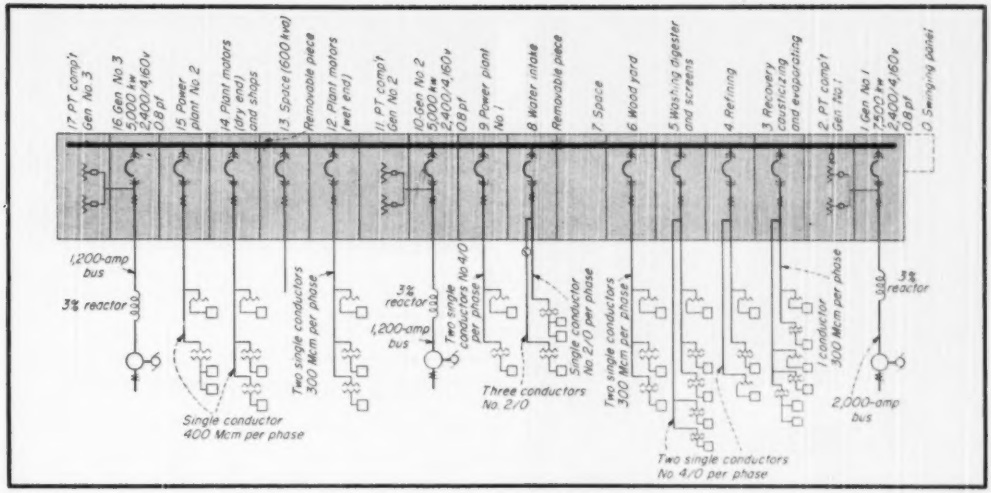
Maintenance

By A D SIMPSON
Power-Plant Superintendent
Macon Kraft Company

► NEARLY TWO YEARS AGO, Macon Kraft Co put into operation a new container-board mill with a rated capacity of 600 tons per day. At present, the average production exceeds 650 tons per day. Behind this production figure stands the necessary power plant to supply process with (1) about 18,000 lb of steam per ton of finished paper (2) electricity at the rate of 14,000 kw per hr (3) treated water totaling 15,000,000 gal a day.

We selected all power facilities with the idea of furnishing energy, electrical or steam, at the lowest fuel cost possible. And, once the energy became available, using it most effectively.

For the steam plant that meant (1) boilers with fuel-burning equipment and furnaces capable of firing the least expensive fuel available (2) a steam and electrical load so balanced that every pound of steam generated could be made to yield its heat energy most effectively (3) methods and equipment to extract as much heat as possible from so-called process waste and low-grade heat sources.


17 PT comp'r Gen No 3
16 Gen No 3 5,000 kw 2,400/4,160v 0.8 pf
15 Power plant No 2
14 Plant motors (dry end) and shops
13 Space (600 kva)
Removable piece
12 Plant motors (wet end)
11 PT comp'r Gen No 2
10 Gen No 2 5,000 kw 2,400/4,160v 0.8 pf
9 Power plant No 1
8 Water intake
Removable piece
7 Space
6 Wood yard
5 Washing digester and screens
4 Refining
3 Recovery causticizing and evaporating
2 PT comp'r Gen No 1
1 Gen No 1 7,500 kw 2,400/4,160v 0.8 pf
0 Swinging panel
1,200-amp bus
3% reactor
Two single conductors 300 Mcm per phase
Single conductor 400 Mcm per phase
3% reactor
1,200-amp bus
Two single conductors No 4/0 per phase
Three conductors No 2/0
Single conductor No 2/0 per phase
Two single conductors 300 Mcm per phase
Two single conductors No 4/0 per phase
1 conductor 300 Mcm per phase
3% reactor
2,000-amp bus

2 Well-laid-out load-distribution system improves chances of an uninterrupted power service. All safeguards and controls that would help prevent shutdown for an electrical failure have been put in to back up this distribution system

Keeps Heavily Loaded Plant Running

Production at new Macon, Ga., plant of Macon Kraft Co continues to exceed design capacity. So maintenance for all power equipment has to be pre-planned to tie in with either production programs or scheduled outages

For the electrical system it meant laying out a load-distribution system, Fig. 2, and selecting individual electric drives to give the highest economy in generation and utilization of the electric power.

Both make a large order. But it is one so commonly sought by industry in general, it merits a follow-up for results.

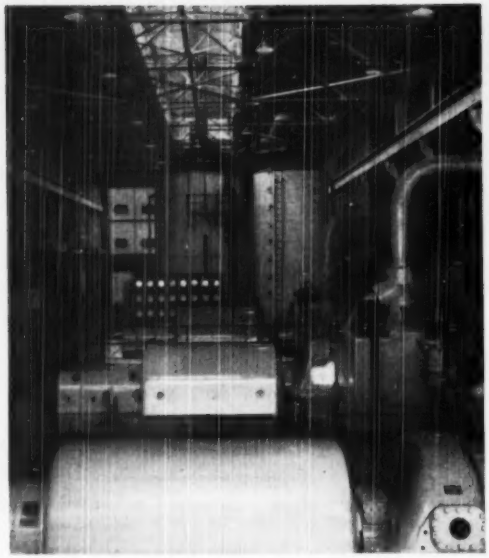
In designing the electrical-power system, we decided on as many synchronous-motor drives (Fig. 1, 3, 4) as possible since we felt this type motor drive would kill two birds with one stone. We'd get a high efficiency drive for the loads and, by oversizing the field windings, we'd deliver a leading reactive kva into the system. Then, by balancing lagging reactive kva with leading, we could carry near a unity power factor on the mill-power system. This gives the most efficient condition for both generation and transmission. In addition, many of the production drives require an absolutely constant speed, which fits in well with synchronous-motor characteristics.

Electrical Load. How is our electrical load divided? We have 7500 connected hp of synchronous-motor drives, used mostly on the larger constant-speed units. Here are the major ones: (1) twelve 350-hp, 2200-v, 450-rpm, .8-leading-power-factor motors for the Sutherland refiners (2) two 600-hp, 2200-v, 327-rpm high-torque motors, direct-connected to Carthage chippers, Fig. 4; rotor element of the synchronous motor connects directly to the shaft of the chipper to provide full power to the chipper disk without slippage (3) one 400-hp, 2200-v, .8-leading-power-factor fan-pump driving motor (4) five 225-hp, 2200-v, unity-power-factor motors driving Nash vacuum pumps, Fig. 1; these motors were selected because at 300-rpm running speed of the vacuum pump, induction motors would have a very low lagging power factor, whereas synchronous motors would give high efficiency regardless of speed (5) two 200-hp overhung-engine-type synchronous motors direct-connected to air compressors. The rotor mounts on the compressor shaft. All these motors are drip-proof, splashproof, or enclosed to protect them against failures from outside water causes.

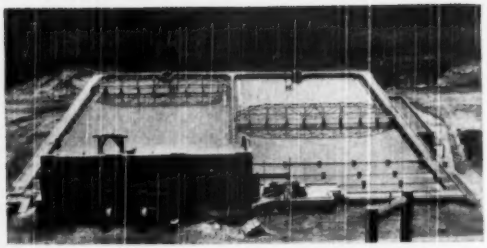
The plant has several thousand connected hp of squirrel-cage induction motors, including two 700-hp units. There are 16 large induction motors in addition to the 22 synchronous motors, above, that operate from a 2300-v supply.

Uninterrupted Service Important. Just as important to us as a high-power-factor electrical load was a system that would give uninterrupted service. We put in all the controls and safeguards we could so electrical failures would not shut down the plant. Starters for the high-voltage motors are totally enclosed, with high interrupting capacity, current-limiting fuses mounted in the upper compartment of the control cubicles for a safety link in case of short circuit. These fuses can disconnect the motor from the line within one-half cycle.

Motor controllers also carry overload safety devices to disconnect the motor in (1) prolonged overload in normal



5 Three main turbine-generators (two 5000 kw, one 7500) and standby diesel-driven 400-kw unit supply energy, 4166 v



6 Okmulgee River water goes through turbine condensers to flocculator; liquid alum and sodium aluminate coagulate it

TYPICAL WATER ANALYSES: GRAINS PER GAL

	River	Plant	Effluent stages		Feed
			1st	2nd	
Hardness	0.9	0.8	0.2	0.0	0.0
P alkalinity	0.0	0.0	2.0	1.6	1.0
Total alkalinity	1.4	1.3	3.0	3.3	1.6
Chloride	0.7	0.7	0.7	0.7	0.4
Silica	0.9	0.8	0.19	0.19	0.12
Phosphate, ppm	0.0	0.0	0.0	10.0	5.0
pH	7.05	7.4	10.2	9.9	9.75

operation (2) voltage failure (3) inability to start.

A prolonged field frequency relay helps synchronize the synchronous motors. The relay applies field excitation to the motors at the correct angle to pull motors into synchronism with the most powerful torque and the least disturbance to the power system.

Three main turbine-generators, Fig. 5, two 5000 kw and one 7500 kw, plus an emergency diesel-driven 400-kw standby unit feed the plant electrical system at 4166 v. Steam-turbine units have 3% reactors for short-circuit protection. Bus bar is sectionalized and has several removable pieces so parts of the system can be isolated for maintenance or emergency. Eleven air breakers distribute the power to air-cooled transformers where it is stepped down from the 4160 v to 2400 and 480 v. Load averages about 14,000 kw.

How has the system worked out? With our system load averaging 14,000 kw and our peaks seldom over 15,000 kw (less than 75% of our capacity) we have no problems on scheduling production machines. We can put on any single machine load without clearing through the boiler room. Our system power factor has held at close to 99%. The rare times when it is below this is because large synchronous machines are temporarily off schedule.

Because production exceeds designed capacity, we have to schedule maintenance of all power-plant and boiler equipment to comply with (1) the weight of paper being run and (2) short-interval shutdowns when periodic repairs can be made on processing equipment. Careful planning, skillful workers, and close interdepartmental cooperation is the basis of our success and recent production records.

Before we get into the steam cycle let's apply the quickest gage to how well any power plant is doing. How much do its products cost? Process steam at the header averages around 46c per 1000 lb. Electric energy at the bus bar ranges from 3½ to 4 mills per kwhr. Both, we feel, reflect good design, good operation.

Steam Cycle. We generate our steam in five boilers—two 150,000 lb per hr, pulverized-coal fired; one 100,000 lb per hr, bark burning; two 150,000 lb per hr, black-liquor recovery type. All develop steam at 900 psi, 800 F, and with allowances for pressure drops deliver this steam at 865 psi to the main header.

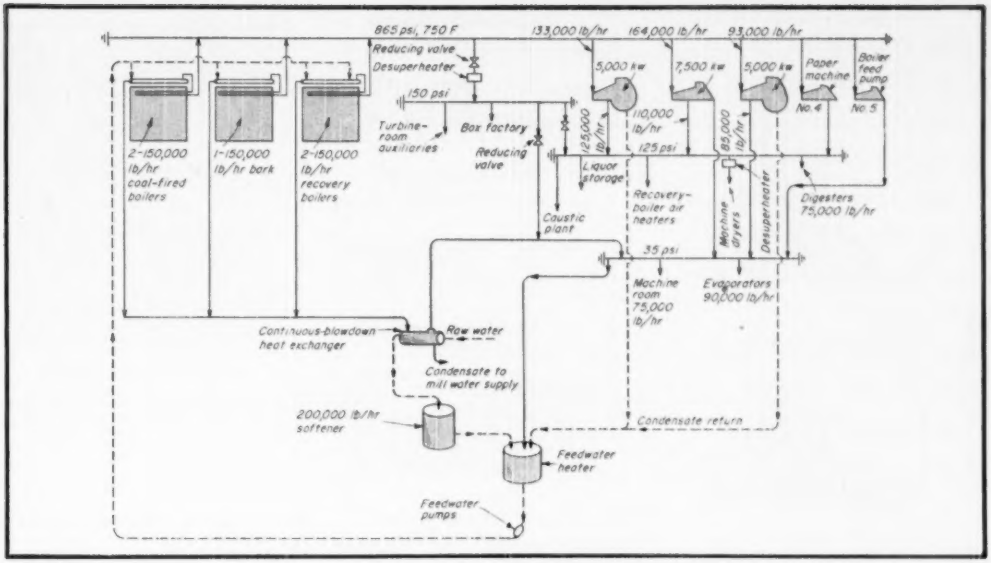
Selection of these steam generators, built to burn widely different fuels, goes back to the prime desire for a plant (1) flexible enough to handle the cheapest fuels available (2) capable of extracting all possible heat energy from mill wastes.

The coal-burning installation has a relatively low heat release, 19,800 Btu per cu ft per hr. Further, the pulverizers can handle coals of low grindability. Both features were included from the design stage because the structure of coals in the nearest fields was known to be unusually firm, averaging below 55 Hardgrove grindability.

We check the pulverizer mills monthly for fineness under normal operation. Under rated conditions of 8 tons per hr with coal of 55 grindability, we get good results with very few adjustments. Wearing surfaces hold up fairly well with an operating life around 35,000 tons.

Once in a while we run into slagging troubles. We then check our operations for variances. We go over our fuel analyses and through our firing methods. We run considerably more fineness checks on our pulverizers. Reason is that we know if we are getting a wetter and harder coal at our pulverizer we may be supplying a coarser coal to our burners and upsetting combustion conditions in the furnace. So far our slagging troubles (rare, fortunately) can be traced to low-fusion coals, which we occasionally get. But the low heat release that we get from our boiler furnace design helps us over most of our troubles along this line.

Our usual coal analyzes as follows: 13,200 Btu, 1% sulfur, 7% ash, 6% moisture, 55 Hardgrove grindability, ash-fusion temperature around 2200 F. With such coal we have an over-all boiler efficiency of 85 to 86%. Actual



7 Five steam generators—two pulverized coal-fired, two black-liquor recovery type and one bark-burning unit—develop steam at 900 psi and 800 F for power and process use, with as little as possible going through to condensing

steam generated per lb of coal varies with the coal's heating value, but as an average we develop steam at a cost of about 0.49 mills per lb.

Refuse Fuel. Our bark-burning steam generator receives in its bin feeder bark fresh from the log-debarking operation, with about 50% or so moisture content and a heat content of 6750 Btu per lb of bark. This rather low-grade waste fuel develops about 3200 lb of steam per ton of paperboard produced. Boiler operates around the clock and produces about 2,000,000 lb of steam per day, nearly 18% of the total plant steam needs.

This boiler we equipped with a Hofft furnace, having three 6-ft 6-in. cells. Our particular furnace is the first of its design. For instance, the usual cast-iron grate was replaced with watercooled dump grates because we felt it would cut down sharply on maintenance.

The bark feeds down from the bin onto a sloping refractory drying hearth. It slides off here to the inclined water-cooled grate where it burns. The ash continues to a dumping grate for removal from the furnace. By proper control of air through the burning section of the grate we can burn this bark successfully with a relatively thin fuel bed.

Whenever we start up the bark boiler we use fuel oil to light off. The bark has so high a moisture content it takes some little time before furnace and setting temperature is high enough to let the drying hearth be of much use. But once under way, the unit fits in well with our over-all plant scheme.

Recovery Boilers. In a mill of our type and size the black liquor reclaimed from the cooled pulp process is considerable. Chemicals in the liquor represent a valuable item. So we reclaim these chemicals in spray-type recovery furnaces, generating steam in the process. These units are rather common to the industry and their operation is well understood.

Steam from these different-type steam generators goes into a common header, Fig. 7, for process or electric power use. Two of the three turbine-generators operate condensing. But under our scheme of load scheduling we put as little steam through to condensing as we can without overheating the rear turbine wheels.

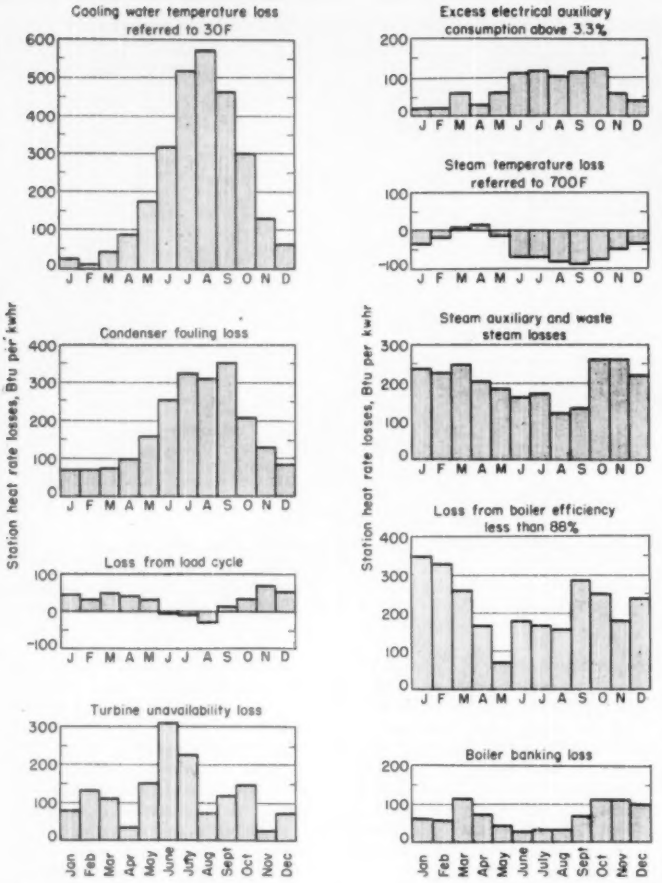
We can control the quantity of steam to the condenser by setting all extraction valve controls below the reducing station pressure. With this operating scheme we get our electric energy at the bus bar at from 3½ to 4 mills per kw.

The various reducing stations throughout our steam-supply system give us high flexibility. We can stabilize our 150-psi process header, Fig. 7, as an example, by (1) controlling steam flow through the reducing station serving this header (2) varying the flow from this pressure level through a second reducing valve to the 35-psi one (3) regulating the quantity of steam to condensing or extraction from the three turbine-generators.

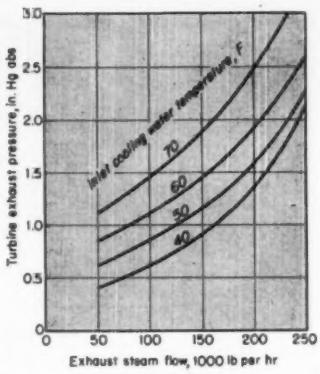
Water Treatment. We use many direct-heating and cooking steps in our normal mill process and as a result run low on condensate return. Boiler makeup goes as high as 45%, or about 200,000 lb per hr. Fig. 6 and teble, p 120, gives a little idea of our water treating setup.

Raw water is taken from the Okmulgee River through the turbine condensers to a flocculator where it is coagulated with liquid alum and sodium aluminate for the removal of suspended matter. The pH is then corrected with lime and the water prechlorinated before going to the mill.

Water for the power plant goes to a 220,000-lb-per-hr, 2-compartment hot-process silica-removal and phosphate-softening unit. In the first compartment caustic soda and magnesium oxide reduce the silica. Anhydrous disodium phosphate in the second compartment removes hardness. Effluent passes through three calcite filters and from there to the deaerator, Fig. 7, which feeds the boiler pumps. A processed lignin derivative containing anti-film for sludge dispersion and catalyzed sodium sulfite is pumped into the suction of the feed pump header. This in a nutshell is our water treatment.


Station heat rate losses, Btu per kwhr
Cooling water temperature loss referred to 30F
Condenser fouling loss
Loss from load cycle
Turbine unavailability loss
Excess electrical auxiliary consumption above 3.3%
Steam temperature loss referred to 700F
Steam auxiliary and waste steam losses
Loss from boiler efficiency less than 88%
Boiler banking loss
J F M A M J J A S O N D
Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec

7 Nine factors causing important changes in monthly heat rates for large metropolitan central station. Difference in monthly values for each factor equals amount of change it causes in over-all monthly station heat rate for same months



6 Typical condenser pressure increases with load, cooling-water temperature

Here's quick way to evaluate effect of change in each factor on over-all station heat rate. This method eliminates guesswork, and shows where improvement's needed. Final part of paper on analyzing steam-electric station results

By B G A SKROTZKI
Associate Editor

Controlling Steam-Station Efficiency: 2

► LAST MONTH we talked about checking actual heat rates against test performance curves of station equipment. This directly measured how well the station was functioning for the given operating conditions. It's only half the story any wide-awake station superintendent wants to know. The other half concerns an analysis of *why* performance changes took place. That's what we'll talk about now. With such information, we'll know where the station weak spots are, and how much we can afford to pay to correct them.

To find the *exact* effect of a change in operating condition on the heat rate entails considerable work. The following "index method" of analysis, however, can be worked through fairly rapidly, and the resulting Btu per kwhr changes are quite close to *true* values.

First step establishes a "base heat rate" for the station. Choose a favorable monthly load cycle that gives a minimum heat rate. Establish the pressure-vs-steam-flow curves for all main condensers at 100% cleanliness over the range of cooling-water temperatures that will be experienced, Fig. 6. Prepare guaranteed and test curves for all units, similar to Fig. 2, at the highest steam temperature expected. Assume a "standard" boiler efficiency slightly higher than can be actually obtained. Assume a percentage of electrical auxiliary consumption less than can be realized.

Figure the "base heat rate" by dividing the "standard" monthly load curve among the units in accordance with best load division practice. Assume the lowest possible cooling-water temperature prevails on all units. In a table similar to Table I (POWER, July, p 118), using guaranteed curves and best cooling-water temperature curve, figure the total

turbine heat input for the station. Divide this amount by the standard boiler efficiency to get boiler input. Divide this by total kwhr output for the standard load curve, less the auxiliary kwhr consumption. Result is the "base heat rate." This performance can never be realized.

Plan of the analysis then changes each of the operating conditions one by one from the "standard" to the actual. Difference in the two station heat rates then measures or is an index of the effect of that operating factor on the actual over-all station heat rate. Table IV lists the plan of calculation and what the heat-rate differentials measure.

H_1 is the "base heat rate."

H_2 is figured with curves similar to Fig. 6, but using the actual average cooling-water temperature. These curves are at 100% condenser cleanliness.

H_3 is based on actual average vacuum at each turbine load rather than vacuum corresponding to average cooling-water temperature.

H_4 substitutes test-performance curves at best throttle conditions for guaranteed. Difference from H_3 measures gain or loss by deviation from guarantee. This has no effect on station-performance variation, but illustrates how factors of interest primarily to the designer can be worked as a routine in this type of analysis.

H_5 is based on actual station-load cycle instead of "standard." Unit load cycle is then result of best load division.

H_6 is figured on actual unit load cycles. $H_5 - H_6$ measures effect of turbine availability and load division. Whenever the most efficient units become unavailable this difference becomes quite marked.

H_7 is based on actual electrical auxiliary-power consumption instead of the assumed "standard" percentage.

H_8 is based on actual steam conditions at the turbine throttles instead of the "standard" values initially assumed for the base heat rate.

H_9 applies the watthour-meter calibration correction.

H_{10} applies the wear correction to the performance of individual turbines.

H_{11} takes into account steam auxiliary consumption and miscellaneous heat losses, which were not allowed for in the base heat rate.

H_{12} is based on the test performance instead of the "standard" efficiency initally assumed.

H_{13} is the heat rate as calculated in the first part of the analysis. Ideally, this should match actual heat rate.

All the differences as listed in Table IV, except the last one, do not give the *exact* evaluation in Btu per kwhr of the effect of each operating factor. To do this would mean using the calculated

TABLE IV — PERFORMANCE ANALYSIS SEQUENCE: "INDEX METHOD"

Heat rate	Cooling-water temp	Condenser vacuum	Unit heat rate	Load cycle	Electric auxiliary consum'tn	Watthour meter calibr'tn	Steam aux and losses	Boiler eff'y
H_1	Stand.	Clean	Guarantee	Stand.	Stand.	None	None	Stand.
H_2	Actual	"	"	"	"	"	"	"
H_3	—	Actual	"	"	"	"	"	"
H_4	—	"	Test Stand.	"	"	"	"	"
H_5	—	"	"	Station	"	"	"	"
H_6	—	"	"	Unit	"	"	"	"
H_7	—	"	"	"	Actual	"	"	"
H_8	—	"	Test actual	"	"	"	"	"
H_9	—	"	"	"	"	Apply	"	"
H_{10}	—	"	Wear Adjmt	"	"	"	"	"
H_{11}	—	"	"	"	"	"	Actual	"
H_{12}	—	"	"	"	"	"	"	Test
H_{13}	—	"	"	"	"	"	"	Overall

Difference	Caused by
$H_2 - H_1$	Cooling-water temperature change
$H_3 - H_2$	Condenser fouling, pump speed, air leakage
$H_4 - H_3$	Deviation from turbine performance guarantee
$H_5 - H_4$	Change in station load cycle
$H_6 - H_5$	Turbine availability and loading change
$H_7 - H_6$	Electrical auxiliary consumption variation
$H_8 - H_7$	Steam-temperature change
$H_9 - H_8$	Watthour meter calibration
$H_{10} - H_9$	Turbine wear
$H_{11} - H_{10}$	Steam auxiliary consumption and heat losses
$H_{12} - H_{11}$	Boiler loading and availability
$H_{13} - H_{12}$	Boiler banking

TABLE V — EFFECT OF OPERATION ON STATION PERFORMANCE OCTOBER TO NOVEMBER

Heat rate — October, Btu per kwhr	13,930
Heat rate — November, Btu per kwhr	13,470
Change in heat rate, October to November, Btu per kwhr	— 460

Change in heat rate due to:	Btu per kwhr
1. Decreased circulating-water temperature (63 to 51 F)	−165
2. Less condenser fouling	− 73
3. Change in station-load cycle	+36
Minimum station load, 60 to 80 mw	
Maximum station load, 530 to 550 mw	
Average station load, 284 to 280 mw	
4. Change in turbine utilization,	− 118
Less outage of Units 7 and 8, 115 to 48 hr	
5. a. Less 4-heater operation on Unit 4	+ 9
b. High-pressure heater of Unit 5, out 11/1 to 11/16	+16
6. Decrease in electrical auxiliary consumption	− 66
Lower cooling-water temperature, less low-pressure operation	
7. Decreased steam temperature (718 to 713 F)	+19
8. Increased steam auxiliary demand and heat losses	+24
9. Increased turbine wear	+ 4
10. Change in boiler loading and availability	−130
Average no. high-pressure boilers on line, 14.9 to 15.6	
11. Decreased boiler air feed temperature (57 to 43 F)	+61
12. Increased banking losses	+13
13. Unaccounted for	− 90
Total change in actual heat rate	— 460

heat rate for actual operating conditions as the base and then recalculating the heat rate for a change in each factor in turn. When changing one factor, all others would be held at actual values. This accurate method entails much more time than is considered feasible. The increased accuracy is usually of no practical importance.

Fig. 7 gives the heat-rate differentials or indexes for the station performance shown in Fig. 1 (POWER, July, p 116). Only the nine important ones out of the 12 computed are plotted. Cooling-water temperature heat-rate loss follows the smooth progression of change in monthly averages of this factor. Condenser fouling shows the trend of fouling algae thriving in warm temperatures and lying dormant in winter months. The year following this analysis the station instituted chlorination practices.

Load-cycle loss is highest in the "dark months" when peak loads prevail. Somewhat more constant loads of summer decrease the loss. Negative losses shown mean that the "standard" cycle chosen was not the optimum one.

Turbine unavailability loss results from more efficient units being out of service and the less efficient ones taking over their normal share of output.

Electrical auxiliary consumption loss shows an increase during the summer because of higher cooling-water pump speeds and use of less efficient units during overhaul periods.

Steam temperature loss varies in this particular instance with fouling of boiler superheater surfaces. Waste and auxiliary steam losses depend on the operating conditions prevailing. Variation in boiler efficiency depends largely on availability of the most efficient boiler as well as the loading. Banking losses are higher during the peak-load season in the cold weather.

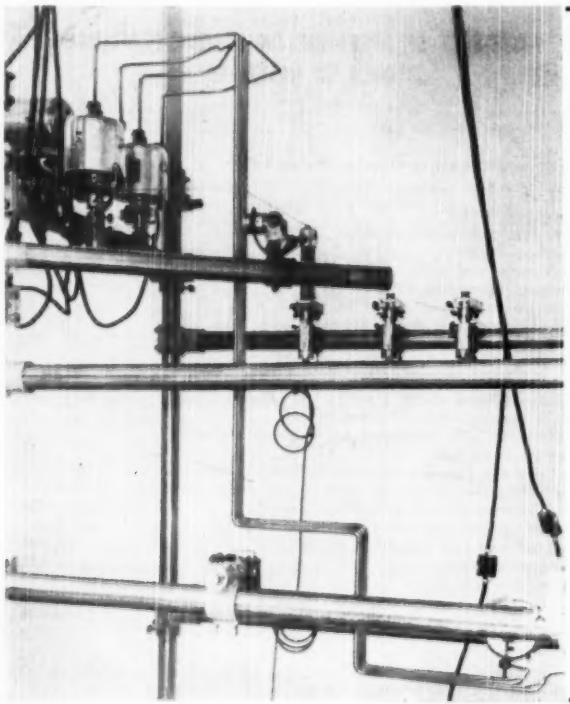
Analysis Form. Most useful form of the analysis is shown in Table V. Here the breakdown is figured from the change in indexes for the months of October and November. Method of calculation makes these index differentials additive, so their sum ideally equals the change in actual heat rates of the two periods. Note that the unaccounted-for item amounts to only –90 Btu per kwhr, less than 0.7% of November heat rate.

Significant items that point up the value of the analysis are the 165 Btu-per-kwhr drop attributable to the 12-F drop in cooling-water temperature. This accounts for only 36% of the total change in actual heat rates. Decreased condenser fouling, a separate effect from water temperature, accounts for 17% of the total change. Increased availability of the most efficient units, 7 and 8, contributed to 26% of the change. Likewise, increased availability of the most efficient boilers added another 28% to the total change.

In this station only four out of 32 boilers have air heaters, making the other 28 sensitive efficiency-wise to combustion air temperature. The 14-F drop in air temperature caused a 13% rise in heat-rate change. This item is not indicated in Table IV.

Conclusion. This form of efficiency control proved a very illuminating tool in station operation. It removes conjecture about station performance and prevents chasing up blind alleys in the tendency to attribute unexpected changes to only one factor. Usually several unrelated factors prove to be the true cause.

Once all the basic performance data have been prepared, it takes about three man-days per month to collect and classify the log-sheet data and figure the complete analysis.



Model Tests Check H-P Piping For World's Largest Boiler

The four thin lines are models of the main piping system for the largest boiler in the world. This unit goes into service at Hudson Ave Station, Consolidated Edison Co of N.Y., near the end of 1951. The 1,370,000-lb-per-hr boiler supplies 1050-F 1500-psi steam to a 65,000-kw topping turbine.

The 4-pipe system proved most economical and supplied greater flexibility than a one-pipe steam main. The model is undergoing tests in the M W Kellogg Co's piping-system flexibility analyzer. This enables the pipe-design engineers to obtain accurate data on operating stresses. This Kellogg-designed instrument indicates forces and moments through an electrical measuring system.

The piping system under test consists of four 10-in.-dia leads from the boiler (top) to two 14-in.-dia connections to the turbine stop valves and steam chests, bottom right. All piping material is made of 2¼% chrome, 1% molybdenum alloy steel.

ANOTHER *Complete Piping Job by SHAW*

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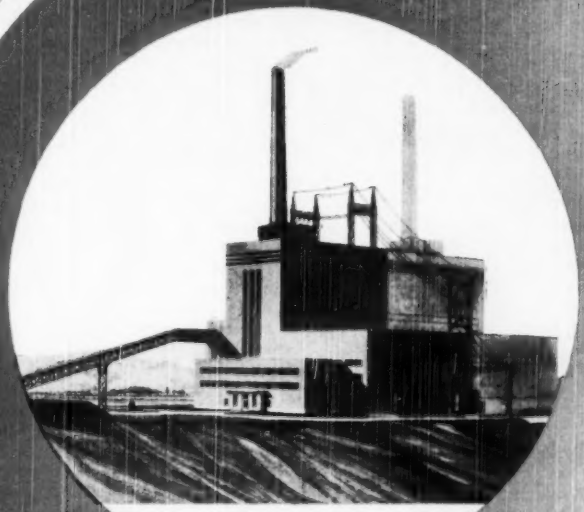

New Tanners Creek plant of the Indiana & Michigan Electric Co., Lawrenceburg, Indiana. All piping in this modern power station, now being constructed, was pre-fabricated and erected by Benjamin F. Shaw Company. Piping will operate under pressure of 2200 PSI, 1050° F. Engineers . . . American Gas & Electric Service Co.

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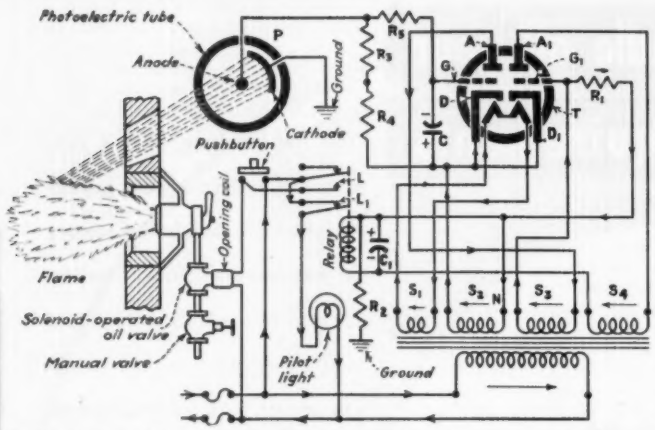
ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*



1 Simple flame-failure-protection system for oil-fired furnace uses photoelectric tube for flame watching, and high-vacuum electron tube for amplification. Push-button opens solenoid-operated fuel valve; operator lights off manually with torch

28—Combustion Safeguards: 1

► ELECTRONIC COMBUSTION SAFEGUARDS are marketed under several names, but all are designed to prevent explosion hazards from developing in oil-, gas- or pulverized-coal-fired furnaces. If the flame fails or other unsafe conditions exist, this equipment in its simplest form shuts off the fuel supply and gives a signal to attract the operator. These systems may be modified in many ways by the addition of various interlocks, furnace purges, automatic ignition, relights, timers, alarms and other devices.

Explosion Hazard. With gas-, oil- and pulverized-coal-fired equipment, explosive hazards can develop during starting and ignition, and under abnormal conditions during normal operation. At starting or lighting off periods an explosion can result from accumulation of unburned gas in the combustion chamber, from defective main or pilot valves. An accumulation of volatile combustible gas during shutdown and incorrect sequence of lighting operations may cause an explosion.

An explosion during normal operation can be caused by loss of flame during which period unburned fuel enters the combustion chamber without immediate ignition.

Flame-Failure Protection. A satisfactory flame-safety combustion protective device should prevent fuel being fed to the furnace until the combustion chamber has been purged of all unburned gas, ignition has been established and correct sequence of lighting off followed. Also, safety of the safeguard sensing element must be established. It might not operate because of a grounded circuit or other conditions of a false flame.

During normal operation the flame safeguard must shut off the fuel to the furnace if (1) the flame or power fails or (2) combustion safety equipment becomes inoperative and indicates unsafe operating conditions by a suitable visual or audible alarm. The safeguard while doing this must also prevent unnecessary shutdowns of the firing equipment.

All the flame-failure protective devices now available meet these requirements in whole or in part. But there may be quite a difference of opinion as to what is required. For example, fully automatic boilers need more elaborate combustion safeguards than do boilers that are always under the supervision of an experienced operating engineer. In this and the two following articles we will study five different designs of electronic flame-failure protection.

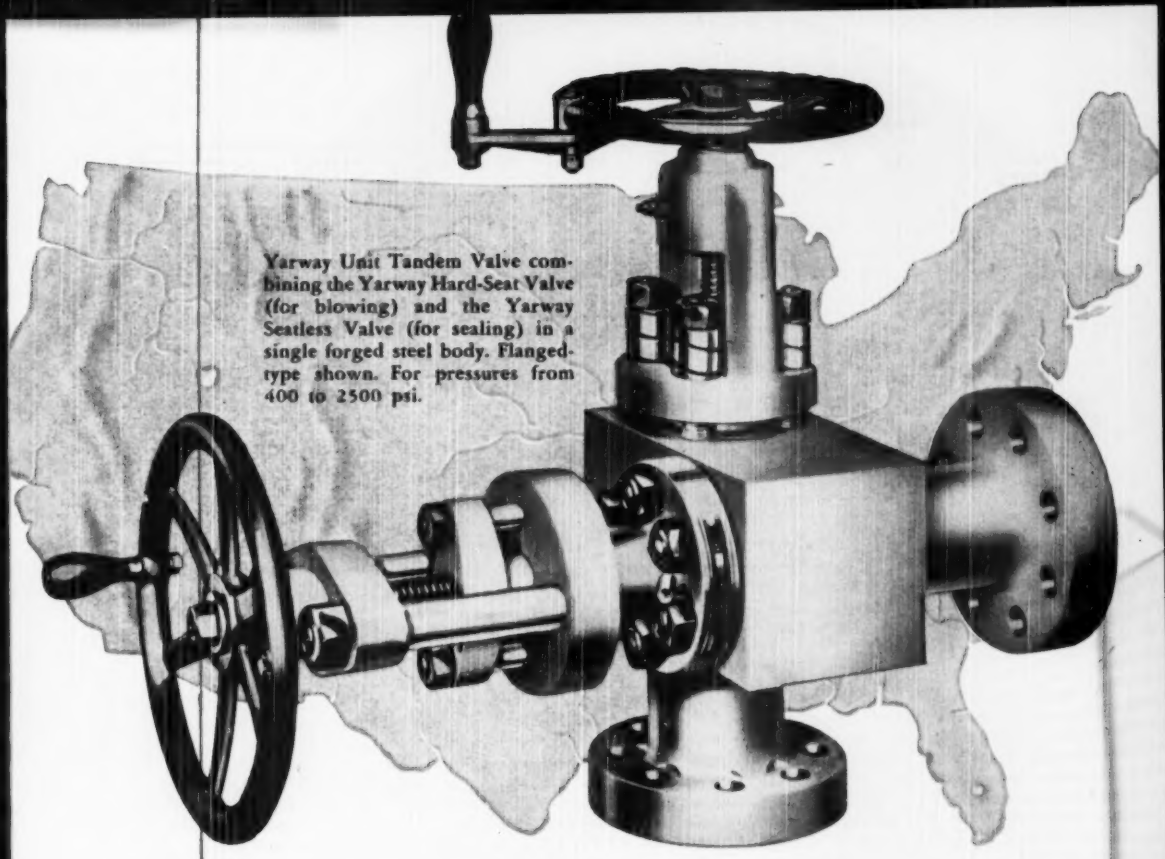
Operating Principle. Operation of these systems depends on detecting existence of a flame by photoelectric tube, or metal electrode, or both. Photoelectric-tube detectors are generally used on furnaces burning pulverized coal or oil in which the flame's luminosity is light yellow or brighter. Photoelectric-tube flame detection ordinarily cannot be applied to a blue-flame burner, such as is used for gas. Here the electrode flame detector is adapted. This system is based on the fact that a flame is a conductor of electricity, having a resistance from 1 to 180 megohms, depending on size and shape of the flame, type of combustion and direction of current flow.

Because the current carried by a photoelectric tube exposed to flame luminosity or an electrode in the flame is too small to operate fuel valves or relays, these small currents are amplified by vacuum tubes to a desired value.

Photoelectric Tube. Fig. 1 is the diagram of a Wheelco Instruments C9 flame-guard system as used on an oil-fired furnace with pushbuttom opening of the fuel valve and manual lighting of the flame with a torch. Diagram shows no-flame conditions, as when the flame guard has been energized, but the fuel valve is still closed. Assume transformer polarity as shown. Secondary S_1 supplies current to heat the cathodes of the twin vacuum tube T.

Transformer's secondaries S_3 and S_4 complete a circuit from cathode D to anode A, secondary S_4, resistor R_1 and secondary S_3. Until there is a flame, photoelectric tube P is inactive and there is no potential on grid G. Consequently current can flow from cathode D to anode A.

Voltage drop across resistor R_1 puts a minus bias on grid G_1. How this bias is produced can be easily seen by considering secondary S_3 alone. If a connection were made between grid G_1 and cathode D_1, current would flow from S_3 to G_1 and D_1, then from D to A and back to S_3. In the absence of the connection between G_1 and D_1, there



Yarway Unit Tandem Valve combining the Yarway Hard-Seat Valve (for blowing) and the Yarway Seatless Valve (for sealing) in a single forged steel body. Flanged-type shown. For pressures from 400 to 2500 psi.

NORTH

WEST EAST

SOUTH

it's YARWAY 4 to 1

From every corner of the country comes the same story—four out of every five high pressure boiler plants are equipped with Yarway Unit Tandem Blow-Off Valves.

Each day's orders add to the evidence. From Ohio . . . 17 new Yarways, making a total of 746 purchased by this large utility over the last 35 years. From California . . . 10 new Yarway Unit Tandems for one company, 9 for another. Texas sends an order of 5 . . . 3 for one new municipal plant, 2 for another. Northern New York wants 7 for new boilers in a well-known utility: And so it goes.

Why this overwhelming preference?

Proved dependable performance, due to outstanding design, sound engineering and careful manufacture . . . plus constant research, leading to mechanical and metallurgical advancements that keep Yarway Valves ahead of changing service requirements.

For latest information on Yarway Unit Tandem Blow-Off Valves, write for Yarway Bulletin B-432.

YARNALL-WARING COMPANY
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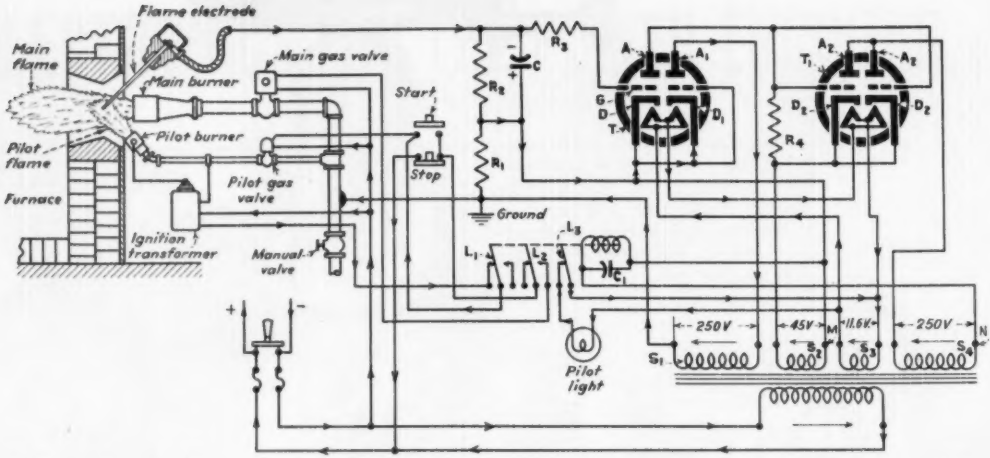
YARWAY

BLOW-OFF VALVES



2 Flame-failure-protection system for gas-fired furnaces includes a flame electrode, main solenoid-operated gas valve, solenoid-operated pilot valve, and automatic ignition. Two dual-element grid-controlled high-vacuum electron tubes amplify impulses. Thus they provide sufficient power to actuate the working parts of the fuel and ignition system

exists a minus potential equal to that of secondary S_2, less the volts' drop from D to A so the right-hand side of the tube cannot conduct. As a result, the relay coil remains dead. A circuit for this coil is from secondary S_2, cathode D_1, anode A_1, secondary S_4, and through the relay coil back to S_2. This circuit is blocked by grid G_1. So the relay's contacts remain closed in the position shown and the pilot light is energized through contacts L_1 to show a no-flame condition.

Fuel Valve Opens. Closing the pushbutton connects the fuel-valve-opening coil across the line. This valve opens, and when the fuel is burning with sufficient flame the photoelectric tube conducts on the reverse transformer polarity from that in the diagram. This circuit is from terminal N of secondary S_4, through resistor R_3 to ground through the photoelectric tube, resistors R_3 and R_4 back to S_2. Anode of the photoelectric tube connects between R_3 and R_4, which puts a minus bias on grid G, equal to the voltage drop across R_3 and R_4, and charges capacitor C to the polarity shown.

When the polarity of the transformer reverses to that in the diagram, capacitor C discharges through resistors R_3, R_3 and R_4, and also keeps a minus bias on grid G that blocks the circuit between cathode D and anode A. Blocking this circuit removes the minus bias on G_1. Then the right-hand side of the tube completes the relay-coil circuit.

This circuit is from S_2 through cathode D_1, anode A_1, secondary S_4, the relay coil, and back to S_2. Energizing the relay coil causes it to open contacts L_1. This extinguishes the pilot light and closes contacts L to short-circuit the pushbutton to put the fuel-valve coil circuit directly across the line. When the pilot light goes out, the operator knows the burner has been lighted and releases the pushbutton.

When Flame Fails. If for any reason the flame fails, the photoelectric tube stops conducting and removes the minus bias from grid G. Current can again flow from cathode D to anode A to give grid G_1 a minus bias to block the right-hand side of this tube, as previously explained. Since the circuit is blocked between D_1 and A_1, the relay coil is deenergized, and contacts L opened and L_1 closed. The former opens the fuel-valve-coil circuit and this valve closes to shut off the oil. Closing contact L_1 lights the pilot lamp to notify the operator that the fire is out.

To prevent the relay dropping out during transient flame disturbances, such as puffs and flicking, that temporarily shut light off from the photoelectric tube, a capacitor C_1 is connected across the relay coil. Time delay in relay opening, after its coil circuit is blocked, depends on the size of capacitor and the charge on it just before flame interruption. This time cannot be adjusted, but if insufficient to overcome effects of transient flame disturbances, it may be lengthened by increasing the capacitor's capacity.

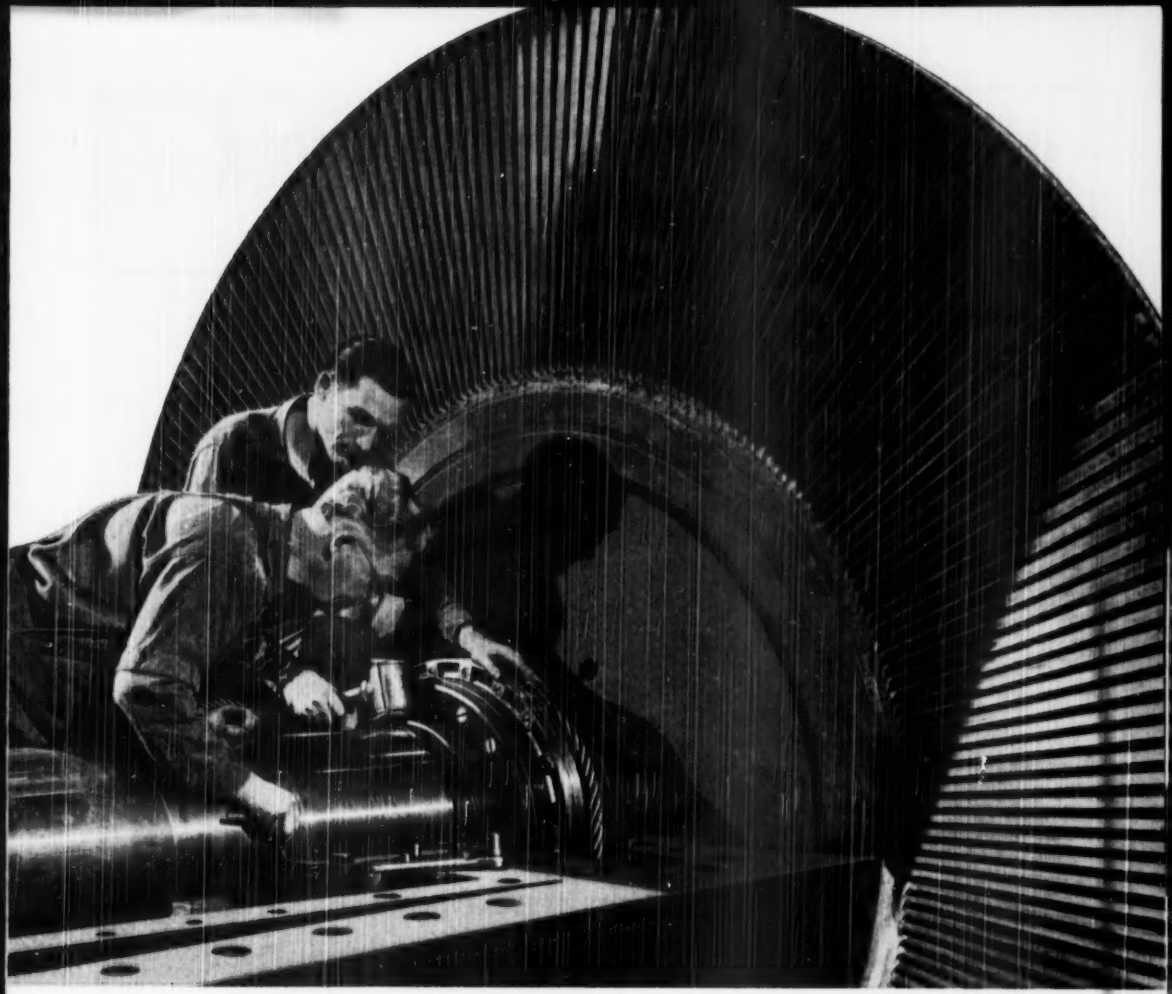
Flame Electrode. Diagram, Fig. 2, is a Brown Instrument Co's unit for a gas-electrode, main gas burner, pilot burner, and automatic ignition. Control part of the system uses two dual vacuum tubes T and T_1, connected as a 2-stage amplifier. Assume no-flame conditions with the line switch closed. Cathodes of the two tubes are heated and the pilot light energized from transformer secondary S_3, as indicated by arrowheads. Secondary S_1 completes a circuit through a resistor R_3, cathode D_1 and anode A_1 of tube T and back to S_1.

Under these conditions, grid G does not have a minus bias, and this side of the tube conducts when the polarity of secondary S_2 is the reverse of that shown. This circuit is from terminal M to cathode D_2, anode A through resistor R_4, back to S_2. Voltage drop across R_4 puts a minus bias on the grids of tube T_1 to block the relay-coil circuit. This circuit, when not blocked, is from terminal N of secondary S_4 through the relay coil, secondary S_2, cathodes D_2, anodes A_2, back to S_4. Note that resistor R_4 is the couple between the stages of the amplifier.

Closing the start pushbutton completes circuits from minus line through the ignition coil, contact L_1, start and stop buttons, back to the line, as indicated. A circuit is also completed through the pilot-valve coil, the start and stop buttons to the line. Pilot valve opens and ignition system lights the pilot flame, which contacts the flame electrode. Then a circuit is completed from secondary S_1, through the flame, resistor R_2 cathode D_1 and anode A_1 back to S_1.

Grid G connects, through resistor R_3, between the flame electrode and resistor R_2, which puts a minus bias on this grid

(*Continued on page* 186)



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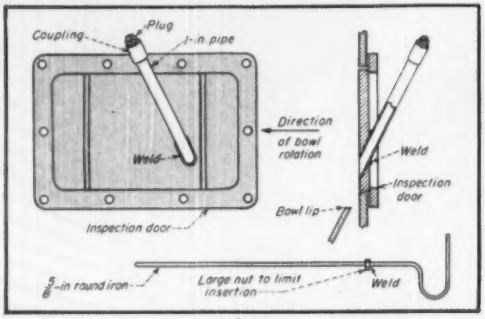
POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE

TOOL CLEARS OUT SCRAP IRON DURING PLANT OPERATION



WHEN WE BURN coal taken from our storage yard, scrap iron that passes through the screens frequently finds its way into our bowl mills. If not cleared out promptly, it often becomes embedded in the side of the bowl, and the mill hammers continuously. At times, we used to shut the mill down to remove the scrap iron.

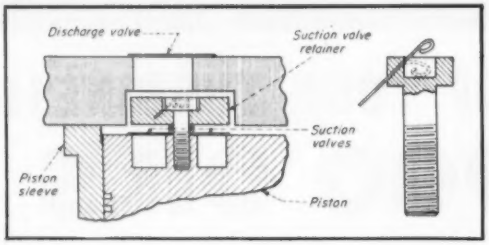
This meant opening the inspection door and pulling out the iron by hand, replacing the door and then restarting. Lost time added to the inconvenience. To avoid all these difficulties, our plant welder built up the arrangements shown in the sketch at the left.

He welded a one-inch pipe into the inspection door at the complex angle shown. Whenever a piece of iron is thrown against the side of the mill bowl, the bar tool shown below can be inserted through the pipe to scrape the side of the rotating bowl. Notice that the pipe angle inclines the tool inserted in the bowl so the scrap iron rides up the tool and falls over the bowl lip. It usually takes some manipulation of the tool to find the iron and then guide it out of the bowl, but it always works. Up to now we have not found it necessary to shut down.

The large nut welded on the bar tool prevents it dropping into the mill accidentally. Plug in the open pipe end must be kept in place to prevent air leakage into or out of the mill during operation.

J A SWANSON *Princeton, B. C., Canada*

SIMPLE RETAINING WIRE PREVENTS SETSCREWS WORKING LOOSE



WE HAVE several 100-ton reciprocating compressors serving our air-conditioning system. The compressors feature interchangeable liners for cylinder bores, aluminum-alloy connecting rods and aluminum pistons. Top of each piston has four tapped holes around the circumference. A retainer plate for the suction valves in the piston head fasten to these holes with Allen setscrews. Bottoms of the retainer plates hold two ring-type valve plates backed up by springs (not shown in the sketch above.) As you can see, clearance at the head-end position between piston and cylinder is very small.

Several times the setscrews worked loose causing considerable damage to pistons, connecting rods, liners, etc. We called in the builder to remedy this defect. His solution proved quite simple. He furnished Allen setscrews that had small holes drilled in the sides of their heads. These screws replaced the original ones in the piston head.

After bringing them up tight, we drilled through these holes into the retainer plate for a short distance. We then inserted a small locking wire into the drilled hole through the screw head. The outer loose end of the wire, as shown in the sketch, was curled up and tamped down tight into the socket in the screw head. This arrangement has completely eliminated the trouble of loosening setscrews.

ALLAN ROCKLIN *Chicago, Ill.*

(*Continued on page* 132)

WHY NOT SEND IN YOUR CONTRIBUTION FOR THE 'NOTEBOOK' NOW?

We bet you have gained helpful hints from this department on more than one occasion. Do you realize that this page is made possible only by the cooperation of contributors—practical men in the field? How about doing your bit by sending in your ideas, now? To boot, POWER will pay you $20 for each item published. Send facts and penciled sketches.

"Installed in 1941...Still No Maintenance"

— SAYS POWER ENGINEER ST. BERNARD, OHIO

ACCORDING TO LEO E. HEIMERT, "Their performance can't be beat. They were put in service nine years ago, and we have yet to see any sign of needed maintenance. Regulation has been tops!"

What are the reasons behind this typical performance?

1. Allis-Chalmers Rocking Contact Generator Voltage Regulators have no vibrating contacts, no gliding friction, no complex adjustments. The few moving parts are all supported in jeweled bearings. See below how simple and friction-free this makes the unit.

2. They're genuinely precision-manufactured. Sectors rock on accurately machined commutator segments that are silver surfaced for positive contact, long life.

No wonder Allis-Chalmers Rocking Contact Regulators are preferred by many as the finest for their systems! If you want long years of trouble-free service, specify *Rocking Contact* Generator Voltage Regulators for your next switchgear or switchboard . . . or replace inefficient regulation now! Call your nearby A-C representative or write direct. A-2967

ALLIS-CHALMERS, 952A SO. 70 ST.
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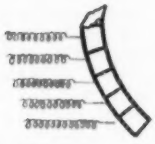
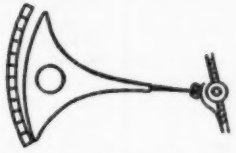
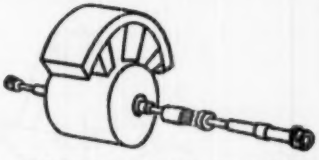
WHY POWER ENGINEERS IN UTILITIES, MUNICIPALITIES AND INDUSTRY PREFER ALLIS-CHALMERS ROCKING CONTACT REGULATORS:



Each commutator segment is connected to a wire wound resistance element that is accurately designed according to the characteristics of *your* generating equipment. Resistance elements are air cooled —commutator is in dust-tight enclosure.



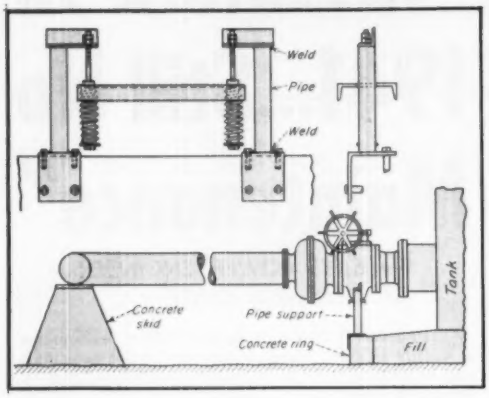
Rocking Contact sector pivots on jeweled bearing . . . has smooth working, hard graphite face that rocks on curved, silver surfaced commutator . . . regulates with slight movement . . . reduces wear . . . maintains accuracy.



Quick acting torque motor drives Rocking Contact Sector . . . has jeweled bearings for rapid, accurate, anti-friction movement. Aluminum rotor reduces inertia . . . increases speed of response.

ALLIS-CHALMERS

SPRING SUPPORT ELIMINATES STRAIN ON OIL TANK'S NOZZLE



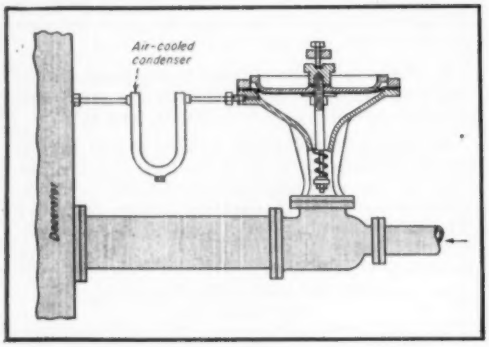
OUR FUEL-OIL TANKS are fitted with 16-in.-dia nozzles. Our oil lines are 12-in., so we used 16x12-in. reducers made up of a 16x12-in. reducing plate flange, a short piece of 12-in. pipe and a 12-in. welding neck flange. These connected the nozzle to the storage-tank discharge valve as shown in the lower sketch, at left.

To allow for settlement of the tank and concrete pipe supports we installed a ball joint after the valve. This reduced the support given the valve and reducer assembly by the concrete skid, and placed a severe strain or bending moment on the tank nozzle.

To eliminate this strain we built the spring support shown in the upper part of the sketch. This design gives the necessary flexibility needed to withstand disturbing forces and allows easy adjustment to meet changing conditions. The crossbar made of a channel rests on the two springs supported by the hanging bolts. The entire assembly is supported by the two vertical pipes welded to the base angles.

H T LIVINGSTON — *Los Angeles, Calif.*

AIR-COOLED CONDENSER PROTECTS AUTOMATIC VALVE DIAPHRAGM



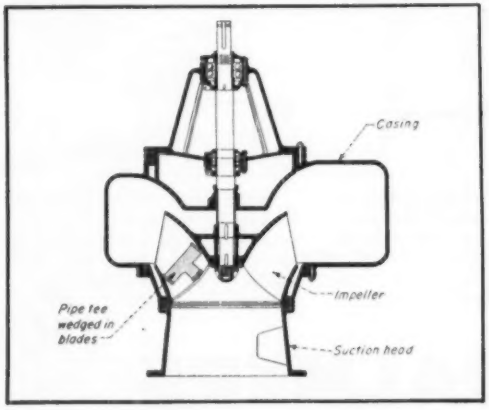
A PRESSURE-REDUCING VALVE controls extraction steam to our feedwater deaerator. It keeps steam pressure at 17.5 psia corresponding to the required saturation temperature. The large valve lift of 1¼ in. keeps the 18-in. diaphragm constantly under tension.

Originally the lower side of the diaphragm connected to the deaerating chamber directly through a ⅜-in. copper tube. This exposed the rubber diaphragm directly to the high steam temperature, resulting in frequent maintenance needs.

We solved this problem by inserting a U-tube condenser in the line connecting deaerator and valve diaphragm. Only condensate of a relatively low temperature now touches the diaphragm. This cuts replacement needs way below former experience. The U-tube consists of 1-in. wrought-iron pipe with two legs 12 in. long and 6 in. apart. Screw plug in the bottom makes draining and cleaning an easy chore.

WU HUNG-CHIEN — *Keelung, Taiwan, China*

HOW TO AVOID TROUBLE—ALWAYS INVESTIGATE IMMEDIATELY



MANY UNBELIEVABLE THINGS can and do happen in power plants. Here's what happened in ours, not so long ago. No. 2 pump, 45 mgd, driven by a synchronous motor suddenly dropped its output by 10 mgd. The electrical meters checked the flowmeter on this. Nothing else was out of order.

We put No. 4, an identical unit, on the line and it came up to its normal rating without incident. We then opened the discharge check valve on No. 2 and found it rotated freely on reverse flow. The only thing left was to open up the pump. After removing a handhole plate we found a 5-in. pipe tee wedged between the blades of the mixed-flow impeller, as shown in the sketch.

The tee had traveled over 25 ft through a horizontal suction pipe from the wet well and was lifted over 7 ft into the impeller. We easily removed the tee, and the pump promptly delivered its rating without further trouble. The moral of this story—investigate at once when conditions depart from normal. If we had disregarded the drop in capacity, the tee could have dropped out and wrecked the pump.

F J ARDOLINO — *Brooklyn, N. Y.*

In the Interest of Water Conditioning

The Betz Indicator

It has always been the policy of The Betz Organization to publish and distribute informative literature pertaining to the many-faceted subject of industrial water conditioning. As new developments occur, or as established practices are improved upon, we publicize the information.

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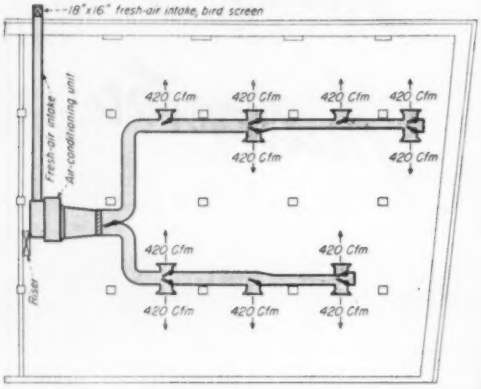
PROBLEMS FROM THE PLANT

THIS MONTH'S QUESTION: CAN AIR-CONDITIONED PLANT AVOID DRAFTS?



WE'RE PLANNING a new plant for manufacture of small metal parts. Each floor will be air conditioned as in sketch. Room temperature needed is 58 to 62 F with a relative humidity of 50%. One hundred girls will be employed on each floor.

We're up against two problems. First, each floor must have good air circulation. "Dead spots" will affect product quality, increase rejects. Second, drafts must be avoided. The girls will all be sitting and if there is the slightest draft some will complain.

I've been wondering about using a perforated ceiling or more ducts and outlets. To avoid dead spots I think a return duct should be installed. We have to get good circulation but cannot have any drafts. We're aiming for smooth distribution at low initial cost.

I'd appreciate help from POWER readers who know how to layout an air-conditioning system. Sketches showing supply and return duct layouts or use of a perforated ceiling will be most helpful.—*BL*

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for: answers accompanied by sketches or photographs command additional pay

Readers Answer the May Question

Why Don't Feedwater and Steam Flowmeters Jibe?

(This question from the May issue is followed by best answers from readers.)

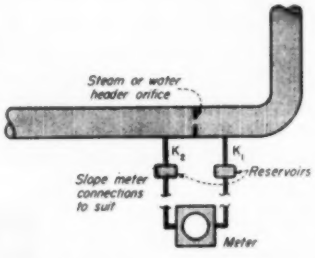
ABOUT TWO YEARS AGO *we installed five new flowmeters to check steam output and feedwater input to boilers. Since that time we just can't get the total steam output figures to jibe with the feedwater input. At high-consumption periods the steam meters total more than the feedwater flow. The opposite holds true for low-consumption periods. Breakeven point is about 700,000 lb per day; see sketch below.*

We've checked the meters up and down the scale with a manometer and their accuracy appears OK. We use undamped reciprocating feedwater pumps. Boiler concentrations indicate 3 to 5% blowdown.

We burn fuel oil in hrt boilers and figure 68 to 70% efficiency using the feedwater consumption figure, and 72 to 75% with the steam-flowmeter totals. On the face of that it looks like steam-flowmeter trouble. But what flaw in installation could cause a breakeven point at 700,000 lb per day? That's assuming there was an error in installation.

Here's another lead: Last summer we ran a calibrating test on the feedwater meter by checking the capacity of one of our boilers. This test showed the feedwater meter was 10% fast at 20% capacity, 14% slow at 40%, and 8% slow at 75%. This checked roughly with the feedwater integrator under actual conditions. There is no leakage through the bypass around the orifice. We even installed new valves to be sure of this point.

If we assume the steam flowmeters are correct we get an efficiency of about 75%. This seems too high for hrt boilers at an average of 11-12% CO_2.—CH



Check Meter Connections

THIS IS MY IDEA OF *CH's* trouble. If meters have been checked and are OK, the trouble may be found by finding out whether the two meter lines, say K_1 and K_2 in sketch, are blocked. Or taps in metered line may be burred and not flush with inside of pipe.

Meter lines should be sloped to meter, one inch per foot. K_1 and K_2 taps should be the proper size. Locate orifice taps according to manufacturer's instructions. See that orifice is correct size with face turned in right direction and centered. Tab on orifice must be in correct position. Reservoirs in K_1 and K_2 must be level and vented.

LOYAL HAGGARD *Cincinnati, Ohio*

Use Correction Factor

I'LL ANSWER *CH's* question by showing him what our plant does. We use about 4-million lb of water per day and base all efficiency calculations on feedwater. After all, what goes in must come out, and in this case it's steam.

To make his two meters, steam-flow and feedwater, jibe, *CH* would have to keep a constant feedwater temperature to be accurate in his calculations. As he probably knows, most feedwater meters are calibrated for a certain temperature; any deviation from this temperature requires a correction factor

On Ship or Shore, draw on this fund of Anaconda Condenser Tube experience

The condenser installations at the Harbor Steam Plant, Department of Water and Power, Los Angeles, using 272,000 pounds of ANACONDA Super-Nickel Alloy 702 Tubes (70-30 Cupro-Nickel), are typical of American Brass Company technical service.

For 20 years American Brass Technical Department engineers have been studying the growing pollution of cooling water from Los Angeles Harbor—and its corrosion and wear of condenser tubes. Case histories of many installations operating under parallel conditions clearly indicated the use of ANACONDA Super-Nickel Tubes.

But today the pollution of Los Angeles Harbor is beginning to be cleared. Tomorrow a different alloy may be expected to do the job. Then, American Brass Technical Department engineers will document their new recommendations with studies of the new conditions . . . with convincing performance records of the ANACONDA Condenser Tube Alloy that best meets those conditions.

These performance checks of ANACONDA Condenser Tube installations—both marine and stationary—have built experience for which there is no substitute. That experience is yours simply for the asking. Just write to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

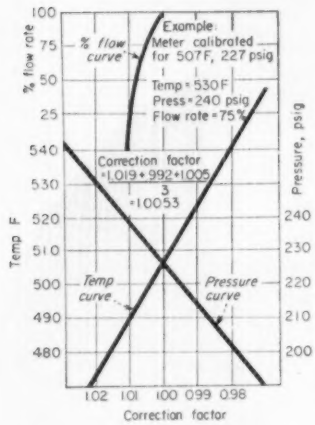
60117

A Los Angeles Harbor Station condenser containing over 10,100 ANACONDA Super-Nickel 702 Tubes (70-30 Cupro-Nickel) ⅞ in. O.D. by 26 ft., 3 in. long.

For efficient heat transfer ANACONDA® CONDENSER TUBES

based on specific volume. His best bet is to use average feedwater temperature to economizer, based on hourly reports. From this he can calculate total water using it for his efficiency calculation. Correction factor used should correspond to this average temperature.

GERALD J TROSKE *Bay City, Mich.*



Plot Correction Curves

SINCE *CH* RAN A TEST on the feedwater flowmeter while checking capacity of one of his boilers he knows corrections to apply to metered feedwater flow to obtain actual flow. His main problem is his steam-flow measurement.

Clue to the problem is his question, "But what flaw in installation could cause a break-even point at 700,000 lb per day?" All steam-integrating meters are designed for certain conditions. In *CH's* case, condition is probably satisfied at 700,000 lb per day. If he writes the manufacturer of this metering equipment he will furnish correction curves.

Meter corrections depend on flow rate, temperature and pressure of the steam. These curves can be constructed but require much time. I will be glad to give him information on how to construct the curves. The sketch above is an example of curves for one particular instrument. Each instrument design has its own set of curves.

LOUIS S GEE *Abilene, Texas*

Change Meter Scales

CH DOES NOT MENTION name or type of meter he uses. This makes analysis hard.

Checking differential pressure across orifice is difficult. At low flow rates change in pressure across orifice is small for appreciable change in flow rate. He can do as well by assuming flowmeter matches orifice on confirmation of manufacturer, and turn his attention elsewhere.

Turbulent flow from tees, elbows and scale deposits on upstream side of orifice may cause large errors. Often pipe cleanliness is almost impossible to check and should be put off until other possibilities have been exhausted.

Flowmeters should always read as near full scale as possible. That is the range of greatest accuracy. It may mean changing scales in fall and spring as steam demand changes.

Presumably *CH* has checked transmitting device of his meters, and integrator and indicator show true information as sent from orifice. This is done by isolating manometer from remainder of system and simulating 0, 20, 40, 80 and 100% of full-scale readings while checking integrator.

If meters receive pulsating flow they read in error and there is no cure except to remove pulsations. A receiver, as on an air system, or moving orifice into region of steady flow does the trick. Above all, don't guess at what meters should read. If we were that good at guessing, the flowmeter people would soon be out of business and it looks like they are here to stay.

W M MONTGOMERY *Des Plaines, Ill.*

Typical Causes Explained

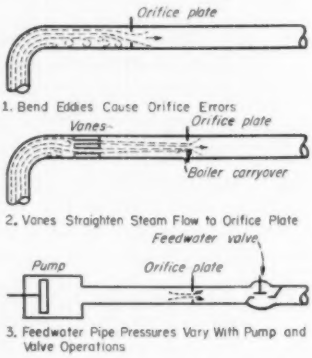
CH's FLOWMETER ERRORS may have several causes. Here's the way they stack up with me.

1. Layout—Orifices installed too close to pipe bends. Eddies produced by bends cause improper orifice differentials and flowmeter errors, sketch 1. This error can vary with flow rate since eddies change with flow. It is probable that at 700,000 lb per day, eddies are such that meters read correctly.

To correct, use vanes for straight flow of steam to orifices, sketch 2.

2. Installation errors—Orifice plate not centered, or flange bolts improperly tightened.

3. Accumulation of boiler carryover on downstream face of steam orifices, sketch 2, causes steam flowmeters to indicate high. Dirt on rim of upstream face of feedwater orifice may cause meter to indicate low.



4. With correct steam meters, feedwater meter may indicate low because pressure in feedwater pipe may be different from pressure for which orifice and meter are calibrated. Pressure could be caused by variation of boiler-feedwater-valve opening, or fluctuation of discharge pressure of undamped reciprocating pump, sketch 3. Combined action of valve and pump may cause such orifice pressure differentials that feedwater meter indicates "high" at low boiler capacity and indicates "low" at full boiler capacity. At 700,000 lb flow, pump and valve conditions may produce orifice pressure differentials for correct reading.

This error could be checked by simultaneous recordings of pump discharge pressure, orifice upstream and downstream pressures, and feedwater valve operation.

W H MILLER *Lancaster, Pa.*

Norton Savage Was Right

We would like to say that the obvious error in Norton Savage's answer (June, p 130) was a printer's slipup. But it wasn't. We erred in reading his original answer and discounted the fact that torque varies as voltage squared. Hence the first paragraph should be corrected to read, "Starting and break-down torque are about $(1 \div 2.4)^2$ times that developed at the 25-cycle hp rating. Hp at 60 cycle is about (1 ÷ 2.4) times the 25-cycle rating.

And is our face red!—*The Editors*

10 Points to Establish

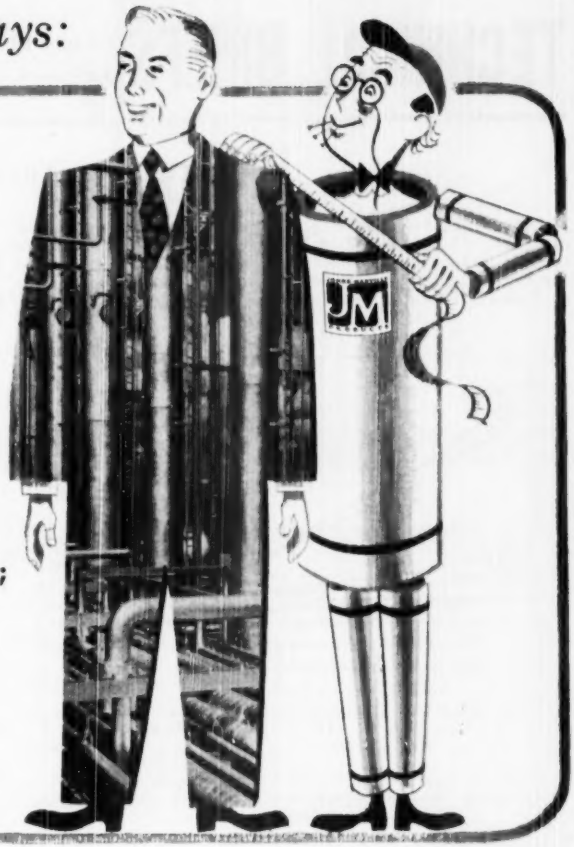
FROM *CH's* DATA any solution is open to question if all meters are assumed in good repair, properly installed and correctly calibrated. Also, quantity of water and flash steam lost by blowdown and through traps can't just be guessed. Accurate instruments and exact methods are needed to check apparent feedwater

(*Continued on page* 182)

Mr. Insulation says:

"Buying insulation is like buying a suit of clothes:

—the better the materials; the more expert the tailoring, the better your investment"



Just as no one cloth can be used for every suit of clothes, there is no one raw material that can serve as the ideal insulator for every industrial insulation job.

For this reason, Johns-Manville manufactures a wide variety of industrial insulations—of asbestos and other raw materials—each of which is designed for a special purpose. These insulations span the entire range of temperatures from 400 F below zero to 3000 F above.

But, again, there is much more to the story of insulations than their manufacture. In order to get the greatest return from your investment in them, they must be expertly engineered to the job, and then skillfully applied.

Johns-Manville makes available to you the service of experienced insulation engineers, and highly skilled mechanics for the proper application of Johns-Manville insulations.

If you are contemplating an insulation installation for your plant, it will pay you to look into this Johns-Manville insulation service. For further information just write Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville *first in* **INSULATIONS**

TECHNICAL BRIEFS

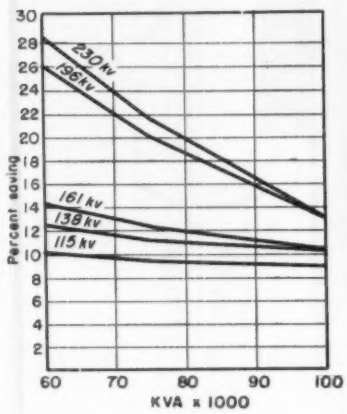
ENGINEERING DEVELOPMENT HERE AND ABROAD DIGESTED FOR BUSY POWER MEN

REVIEWED IN THIS ISSUE

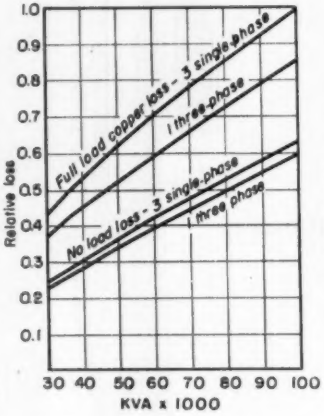
TRANSFORMERS: Engineering and Economic Considerations Applicable to Large Power Transformer Installations • Selection and Application of Power Transformers for Generating Stations • Choice of Main Power Transformers—Summation on Technical Session for Transformer Selection

POWER GENERATION: Hydroelectric Generator Excitation Experience at Grand Coulee • Determination and Allocation of Capacity • Benefits from Interconnections

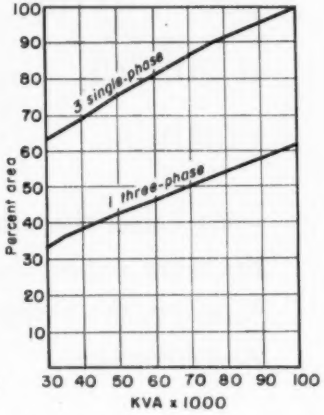
SMOKE PREVENTION: Flyash Measurement in Small Plants



1 Percent savings, 3-phase transformers against three single-phase ones



2 Relative losses are compared for 3-phase and single-phase transformers



3 Projected floor-area differences for single-phase vs 3-phase transformers

Transformers

ENGINEERING AND ECONOMIC CONSIDERATIONS APPLICABLE TO LARGE POWER TRANSFORMER INSTALLATIONS, *by Charles M Short, Dept of Water & Power, City of Los Angeles, Los Angeles, Calif. and William G Hart, General Electric Co, Los Angeles, Calif.* Aim is to re-examine methods to reduce first and long-term transformer cost. Each acceptable and approved method is analyzed as to (1) reduction in capital investment, (2) sacrifice in reliability, (3) present extent of adoption by the industry. All pertinent data on characteristics and comparative costs for various types of transformers are included to aid the application engineer in determining which type best suits his needs. The authors go a step farther and include the factors considered, methods employed and techniques used in an engineering and economic study to determine type of transformers in a large central station.

Typical analysis includes the comparison of three single-phase transformers to the 3-phase units. In 1949, three times as many 3-phase units were sold as the three single-phase transformers preferred some 15 years ago. Reason for this transition simmers down to: lower first cost, lower losses and lower cost of installation because of reduced space requirements, more compact foundations, and elimination of complicated bus-work to complete delta and wye connections. The authors recognize that the problem of providing a spare transformer has and will often influence the decision to use single- instead of 3-phase transformers.

A comprehensive survey of popular types of transformer cooling is then considered. Each is evaluated on an economical basis, including matters of core loss, total loss, impedance, floor area and waste.

Next point of discussion is insulation. Generally speaking, insulation levels within transformers have been lowered. This is possible because of the reliability of modern lighting arrestors. This lowered insulation level has advanced to the point where many electric utilities have adopted the practice of solidly grounded circuits rated 138 kv and above, using transformers insulated for the next lower class. For instance, 230 kv insulated for 196 kv; 161 kv insulated for 138 kv; 138 kv insulated for 115 kv. Up to now, there has been no lowering of insulation below these classes, or lowering the level more than

(*Continued on page* 188)

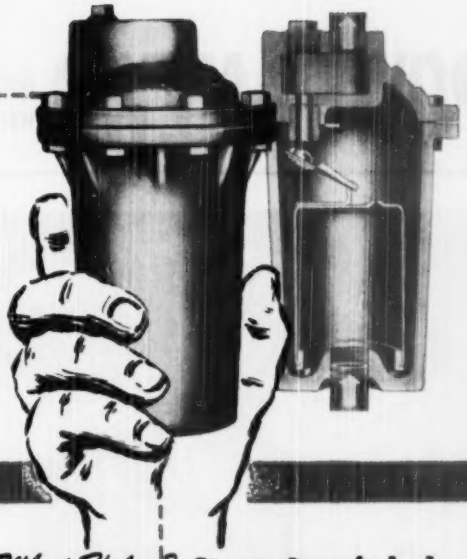
TO OBTAIN COMPLETE TEXT

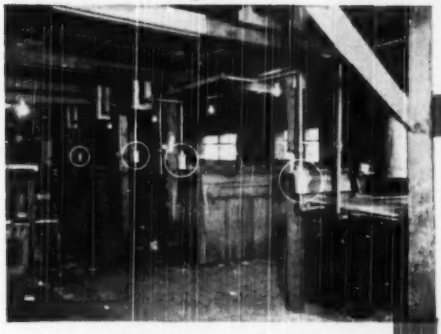
Material for these abstracts comes from one of the following sources:

American Institute of Electrical Engineers, summer and Pacific general meetings, Pasadena, Calif., June 12-16, 1950. Papers are identified by initials AIEE. Obtainable through AIEE, 29 W 39th St, New York 18, N. Y.

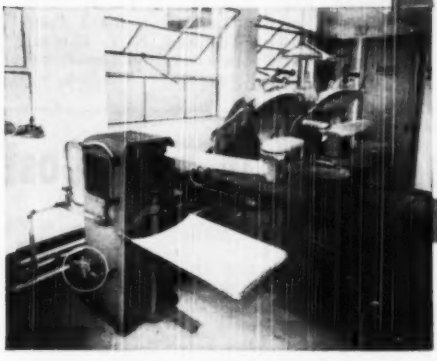
Smoke Prevention Assn of America, annual meeting, Montreal, Quebec, May 21-25, 1950. Papers are identified by initials SPAA. Obtainable from the author at address indicated.

THIS will plug the holes in your boiler!





33 1/3% REDUCTION IN ANNUAL COAL BILL after installing Armstrong traps on cooking vats — a Midwestern lumber company.



$59.62 FUEL SAVINGS PER MONTH after unit trapping a Milwaukee dry-cleaning plant with only 14 small sized Armstrong traps.

What Holes? Steam trap holes!

The orifice in a steam trap is just the same as a hole in your boiler if it leaks steam. A ¼" hole (orifice diameter of a medium sized 100 psig trap) will leak over $100 worth of steam a month. Now, if you had 100 traps... but you don't need to figure the possible steam loss if you have Armstrong traps. Here are a few reasons why:

1. Valve and seat of chrome steel heat-treated, ground and lapped. Will not wire draw or pound out.
2. All other working parts of 18-8 stainless steel for long wear and corrosion resistance.
3. Buckets have generous buoyancy margin of safety to prevent prime loss.
4. Dirt can't settle on valve or seat to hold orifice open.
5. Nothing to stick or bind to prevent valve from closing
6. Backed by 40 years of experience in building inverted bucket traps.

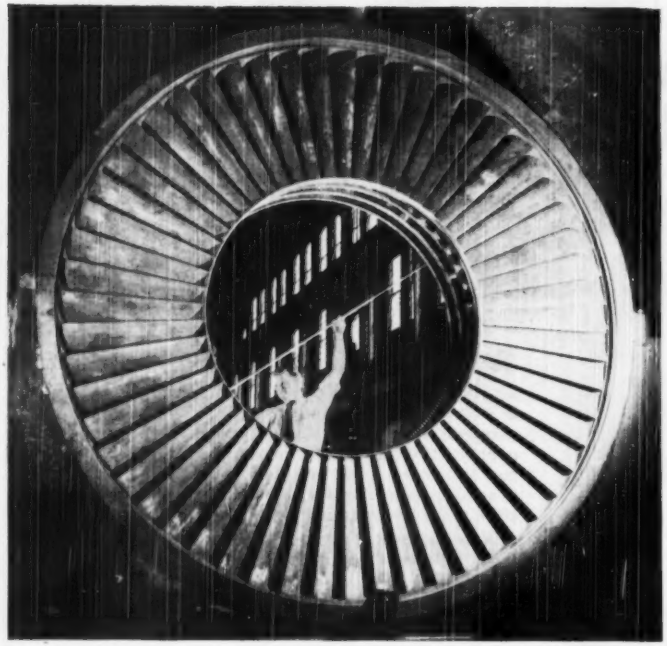
Get the full story from your Armstrong distributor or write for a copy of the ARMSTRONG STEAM TRAP BOOK — complete data on operation, selection, installation and maintenance of traps. Free on request.

ARMSTRONG MACHINE WORKS
812 Maple Street • Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS



FOUR-ROW SLICE of a 22-ft-diameter low-pressure exhaust element for an 1800-rpm condensing turbine (Allis-Chalmers Mfg Co), above, gets a micrometer checking

COMING EVENTS

Sept 19-21—American Society of Mechanical Engineers, fall meeting. Hotel Sheraton,, Worcester, Mass. O B Schier, secy, ASME, 29 W 39th St, New York 18, N. Y.

Sept 26-29—Association of Iron & Steel Engineers, Cleveland, Ohio. T J Ess, managing director, 1010 Empire Bldg, Pittsburgh 22, Pa.

Oct 2-5—Technical Assn of Pulp and Paper Industries, engineering meeting. Netherland Plaza, Cincinnati, Ohio. R T Bingham, TAPPI, 122 E 42nd St, New York, N. Y.

Oct 15-18—American Public Works Association, public works congress and equipment show, Hotel New Yorker, N. Y. F H Zurmuhler, general chairman, Bureau of Public Works, City Hall, New York, N. Y.

Oct 23-27—American Institute of Electrical Engineers, fall meeting, Skervin Hotel, Oklahoma City, Okla. H H Henline, secy, AIEE, 29 W 39th St, New York 18, N. Y.

Nov 27-Dec. 2—American Society of Mechanical Engineers, 19th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York, N. Y. Charles F Roth, mgr, International Exposition Co, Grand Central Palace, New York, N. Y.

Mechanized Mining Lowers Synthetic Fuel Cost

► RECENT DEVELOPMENTS in mechanized mining, at the U.S. Bureau of Mines oil-shale mine near Rifle, Colo., have lowered mining costs to 29c per ton of shale, according to E D Gardner, chief mining engineer, Bureau of Mines, and E M Sipprelle, chief of the oil-shale mine branch at Rifle. This cost is considerably below previous estimates that have been made public and should mean correspondingly lower production costs for synthetic liquid fuels made from shale oil.

Boyd Guthrie, chief of the Oil Shale Demonstration Plant at Rifle, and Lester W Schramm, chemical engineer at the plant, told the semiannual meeting of the ASME at St. Louis that the cost of producing crude shale oil from 30-gal-per-ton shale using new mining and processing techniques would run about $1.50 per barrel. This figure includes estimated out-of-pocket operating costs and depreciation. But it does not include any income-tax levy or profit. But an estimate of the Bureau of Mines a year ago, excluding contract on investment and profit, was just at $2 per barrel. So this latest figure of $1.50 is most encouraging.

The estimate a year ago guessed that gasoline, diesel oil and heating oil made from crude shale oil would be about 8.4c a gal. No similar price was quoted at the ASME meeting.

Boyd and Schramm said the sharp rise of petroleum crude in the last few years, due to increased difficulty of finding new petroleum, together with technological advances in mining and processing oil shale and refining shale oil, is bringing the cost of liquid fuels from petroleum and from oil shale close to the same level.

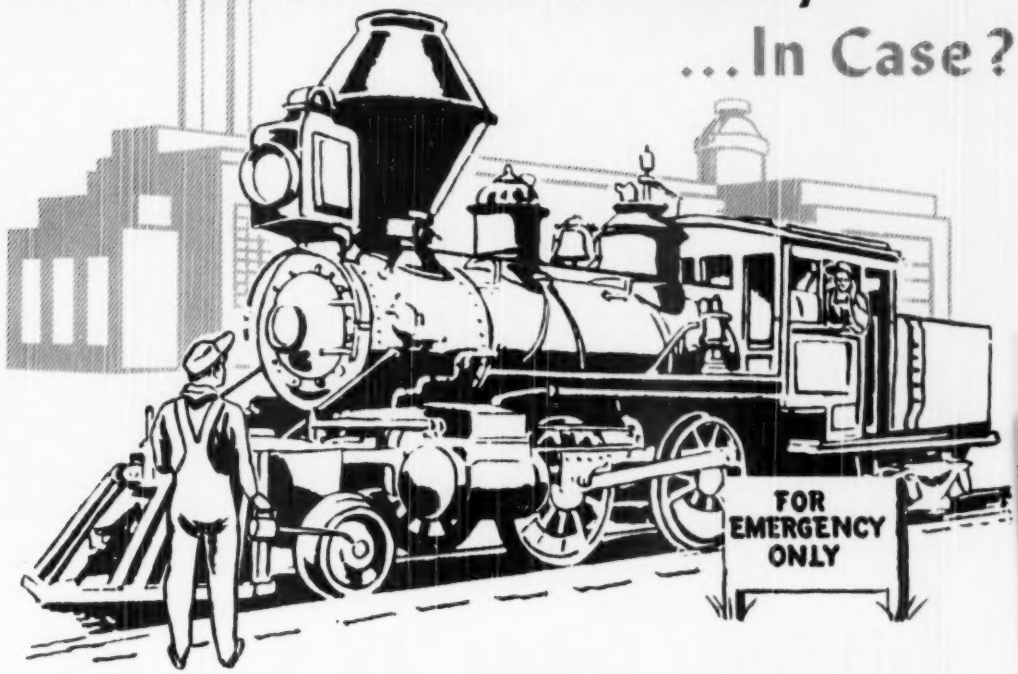
If present trends continue it should not be long before shale oil can supplement petroleum at a comparable price. From the Green River Formation, richest known deposit of oil shale in this country, an estimated 300-billion barrel production can be drawn from a 500-ft thick measure over a 1000-square-mile area.

Near the base of this 500-ft measure is a 60-to-100-ft-thick especially high grade section called the Mahogany Ledge. It is the one where the Bureau of Mines oil-shale mine is located.

Equipment in use includes 4-drill jumbos for drilling heading and bench rounds, a portable 1500-cfm compressor station, a mobile platform from which

(*Continued on page* 198)

Got a Locomotive Handy ...In Case?



EVERY so often a steam locomotive makes news by going to the rescue of a plant where the steam system gave out at a critical time.

This is one answer to continued steam production pending repairs . . . and undoubtedly an expensive one. Simplest—and most economical—is to use the Nalco System and eliminate the chances of boiler down time due to faulty water treatment.

Nalco chemicals and services aim at *water treatment results* from raw water intake to condensate hot well . . . And the thousands of plants now using the Nalco System testify to the accuracy of this aim during the past twenty-six years. Whether your plant is large or small; your water problems scale, corrosion, carry-over—or just plain high cost—unless you have a locomotive handy for emergencies, better check with Nalco today. No obligation . . . and an excellent chance for permanent water treatment security.

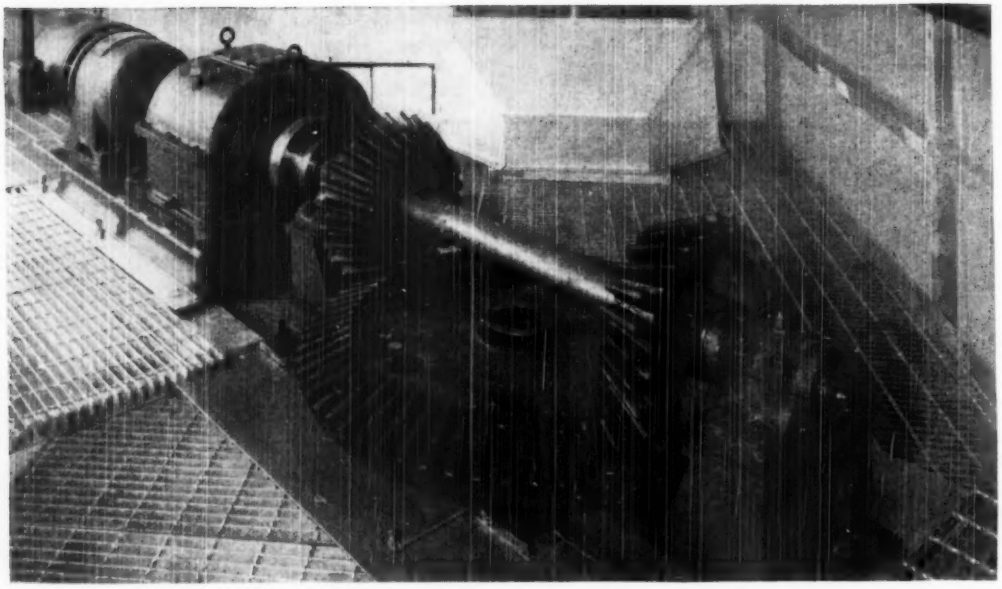
P. S. More steam locomotives use Nalco-treated water than any other kind . . . Perhaps the reason why locomotives *can* be of help in plant emergencies!

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to
Alchem Limited, Burlington, Ontario, Canada

THE *Nalco* SYSTEM . . . Serving Industry through Practical Applied Science

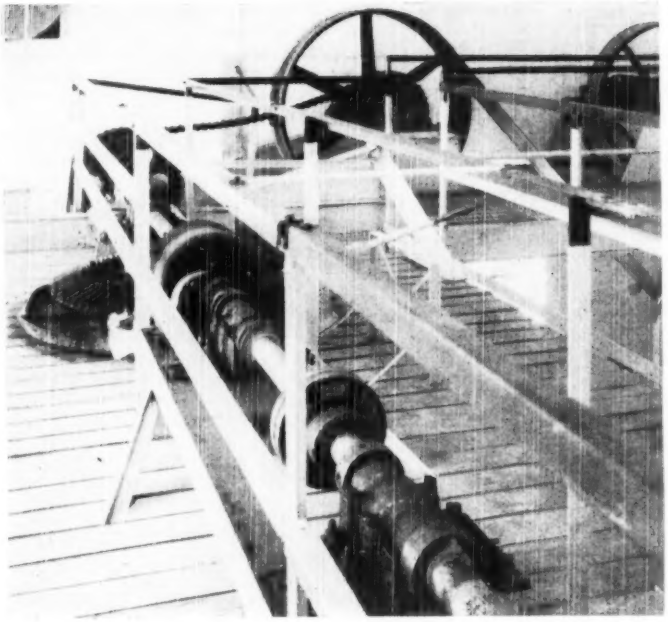


NEW MASH-TUB AGITATOR DRIVE has pushbutton-controlled 25-hp induction motor and fluid coupling, double-reduction herringbone gear and bevel gears at agitator. Only one bevel gear keys to shaft; other, brass-bushed, acts as a hold-down

Fluid Drives Agitate "Old Grand-Dad"

► National Distillers Products Corp of Frankford, Ky., famous for "Old Grand-Dad" whiskey, recently improved two mash-tub agitator drives. They did it by replacing a 60-hp steam engine and line shafting with motorized fluid drives. In old setup *(right)*, the engine drove mash-tub-agitator line shaft through flat belt and chains. Friction clutches in bevel-gear pinions on line shaft connected and disconnected the agitators and the drive.

Each new drive *(above)*, consists of a 25-hp Link-Belt motorized fluid drive coupled to a double-reduction herringbone gear. These two units mount on a welded-steel bedplate. Gear couples to a shaft with two bevel pinions meshing into an agitator bevel gear. One pinion keys to the shaft. The other is brass bushed to run loose and serves as a holding-down pinion. Bevel-pinion shaft bearings mount on a welded-steel bedplate. This insures accurate alignment and minimum maintenance. New drive saves space, cuts repairs.



OLD DRIVE had 60-hp steam engine driving line shaft for two mash tubs through flat belt, chain and friction clutches

Announcing the NEW

JENKINS SWINGTITE

with an exclusive new design that assures smooth action, positive closure, and longer life

In the new Jenkins SWINGTITE Fast-Action Bronze Gate Valve, the exclusive rolling disc and guide track design lengthens valve life and assures maximum tightness as it prevents uneven wear of seating surfaces. As the valve is opened or closed, guide rims around the seating surfaces of discs roll freely over guide tracks cast in the body, distributing wear evenly, dislodging foreign matter, and providing a polishing action for seating surfaces.

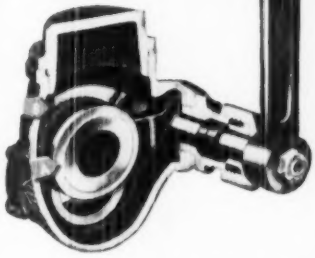
The SWINGTITE can be opened or closed instantaneously and easily with less than a quarter turn of the malleable iron lever which activates the self-adjusting ball and socket type double disc.

Wherever full, free flow is essential . . . where valve opening or closing must be instantaneous . . . you will see more and more Jenkins SWINGTITE Bronze Gate Valves setting new standards of performance and endurance. They are recommended especially for such services as laundry machinery, dish-washing equipment, gasoline and fuel oil lines, fire extinguishing steam lines in kitchens, and dispensing lines to tanks or vats.

Get all the facts on the new Jenkins SWINGTITE. Find out how much smoother-operating, how much *longer-lasting* these fast-action Bronze Gate Valves can be when *Jenkins* builds them. Send for the new folder, Form No. 196, containing full details. Jenkins Bros., 100 Park Avenue, New York 17, N.Y. Jenkins Bros., Ltd., Montreal.

Sold through leading Industrial Distributors

NO OTHER VALVE of its type HAS THIS FEATURE



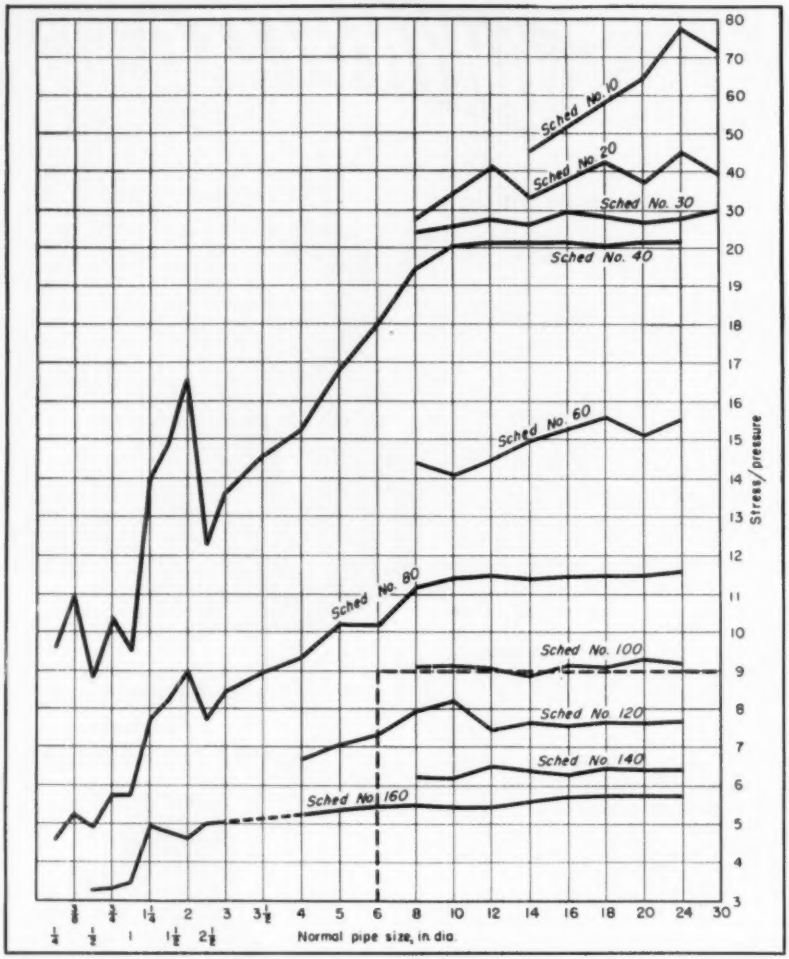
Notice the guide rims (A) of the discs which rotate freely on the guide tracks (B) cast in the body, as the valve opens or closes. This roller action provides a self-cleaning and polishing effect, and also distributes the wear, since the seating position of the discs changes with each closing. Rapid, uneven wear is prevented, and continuous tight closure assured.

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

Jenkins Bros.

Number 218



Pipe Schedule Numbers Found Quickly

► THIS CHART helps find pipe schedule numbers for given applications. It is based on the formulas below and applies to power, district heating, refrigeration and boiler-code piping of welded and seamless-steel pipe.

$$t_m = \frac{PD}{2S + 0.8P} + C$$

$$\frac{S}{P} = \frac{D - 0.8(t_m - C)}{2\ (t_m - C)}$$

t_m = 0.875 × nominal pipe-wall thickness, in.
D = outside pipe diameter, in.
P = maximum service pressure, psig
S = allowable pipe working stress at operating temperature, psi
C = allowance; 0.05 in. for pipe 1 in. and smaller; 0.065 in. for pipe 1¼ in. and larger

Example: Find pipe schedule number for a 6-in. steam line 600-psig 850-F piping material, A-155, Grade B. From *Piping Code For Power Piping Systems*, maximum allowable stress for given material at 850 F is 5400 psi.

$$S/P = 5400/600 = 9.0$$

Follow dashed lines on graph from 9.0 on vertical scale and 6 in. on horizontal scale. Intersection lies between schedule No. 80 and 120 curves. Use schedule No. 120.

M W LARINOFF, *New York, N. Y.*

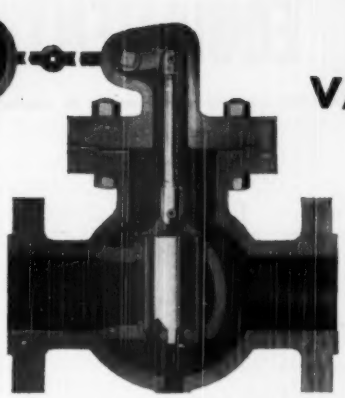
COPES BALANCED VALVES

Wherever you use float valves, avoid losing any of your operating force in the stuffing box. Insist on low and constant valve stem friction.

Make sure of instant, accurate response to your actuating force—no matter what your flows and pressures—by demanding close control of the unbalanced forces found in every valve.

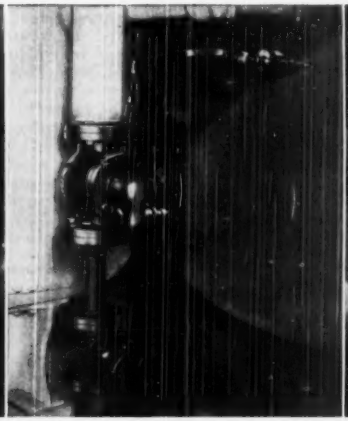
Provide for minimum pressure losses at high flows by requiring your valve ports to be accurately designed for the conditions you specify.

In other words—insist on COPES Balanced Valves. They offer all these important advantages—plus long service life with minimum maintenance. Write in detail about your needs.

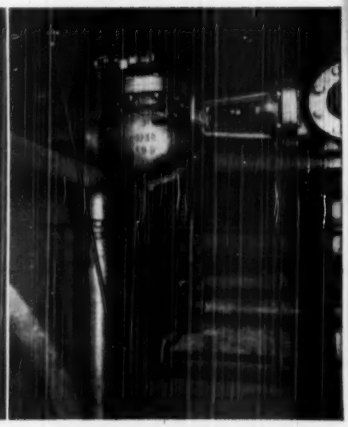


With the COPES Type BI Valve, rotating stem means low stuffing box friction. Accurate balance assures quick and accurate response. Exact capacity you need is provided.

Float-operated COPES Type BI Valve controls flow of condensate from flash tank to storage tank.



Flow of blow-down water from a flash tank is controlled by this float-operated COPES Valve.



Water level in a deaerating heater is controlled by this float-operated COPES Balanced Valve.

NORTHERN EQUIPMENT COMPANY
801 GROVE DRIVE, ERIE, PA.

BRANCH PLANTS: Canada, England, France, Italy and Austria. *Representatives everywhere.*

Bulletin 443-B gives condensed data on all major COPES products. Write for a copy—your letterhead, please. Keep it for reference.

COPES

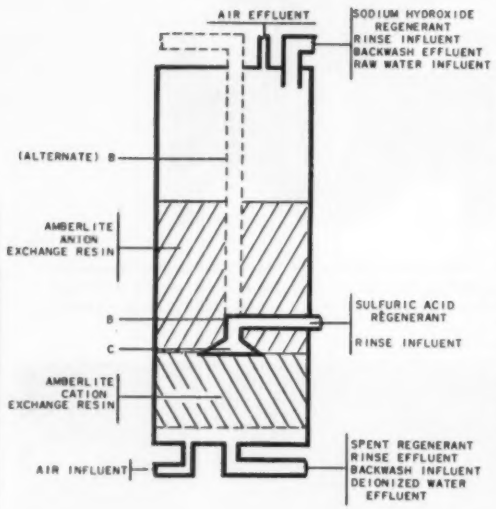
Headquarters for . . .

Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

PLANT EQUIPMENT NEWS

Published monthly as a service to readers

Your information center for new products to solve plant problems. Spot what you need, use handy cards p 192a, to get more details



ONE BED DOES WORK OF TWO WITH NEW SYNTHETIC RESINS FOR DEMINERALIZING

P870 • By now most power engineers are well acquainted with use of synthetic resins for ion exchange. In the familiar process, water flows through one bed of synthetic resin, comes out with mineral salts converted to acids. It then flows through another bed where a different resin absorbs the acids. This 2-part job can now be done in one bed, with new synthetic resins mixed so anion and cation exchange take place at same time. These resins are developments of the *Amberlite* series; the various forms of the new process are called *Amberlite Monobeds*.

Single-bed operation offers these advantages: (1) equipment is simpler and potentially less costly (2) deionization can be more complete (3) rinse needs and regeneration cost can be reduced, and (4) neutral pH can be maintained during deionizing.

When a monobed must be regenerated, the mixed anion and cation resins are separated by a backwash. Difference in density of resins causes them to settle out in clearly defined zones, as shown in diagram at left. Enough alkaline solution to regenerate the anion-exchange resin goes in at the top. Spent regenerant passes through cation-exchange resin below, partly converting it to the sodium form. This minimizes precipitation of calcium sulfate when the cation-exchange resin is regenerated. A brief rinse follows regeneration of the anion exchanger.

Sulfuric acid for regenerating the cation-exchange resin comes in through a distributor at the boundary between the anion and cation resins. So it passes through the cation zone only. A brief rinse follows to remove any excess sulfuric acid. Air jets at the bottom of the unit then mix the resins thoroughly and normal operation resumes.

Equipment builders are now developing units to employ these new resins and a number of applications for water conditioning and chemical processing have been made. Six *Amberlite* resin combinations are available; these have different characteristics fitting them for various applications.

Resinous Products Div, Rohm & Haas Co, Phila. 5, Pa.

COMBINATION BRAKE-MOTOR FOR CRANES, HOISTS, CONVEYORS

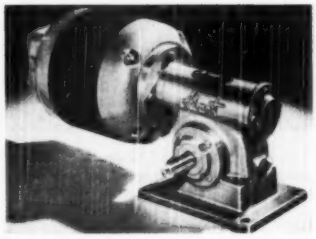
P800 • *Tri-Clad* motors are available equipped with Stearns magnetic brakes in a one-package unit. All types, up to 20 hp, 90 lb-ft static torque, are available with explosionproof, electrically operated brake. Brakes, even on the open-type motors, are totally enclosed. Brake cover is sealed to the motor housing to protect against harmful atmospheres, dust and dirt. And as a safety feature, to protect against personal and equipment damage, the brake will continue to hold even if power fails during operation because of its spring-set, solenoid-release design; an important feature.

These brake combinations are selected to operate at 100 and 150% of full-load motor torque. A single-adjustment nut sets the torque for specific load conditions. In this way, unit operates below maximum rated torque where possible, to conserve brake linings and lengthen brake life. Brake linings are made from high friction material. In normal operation the only maintenance is a screwdriver adjustment to compensate for wear. A wear indicator, viewed through a platsic window, tells when this adjustment is necessary. Manual release is a standard feature and is handled by removing the plastic window that covers the combination hand release and wear indicator.

General Electric Co, Schenectady 5, N. Y.

RIGHT-ANGLE GEARMOTORS P864

With motors of heavy-duty NEMA rating, these right-angle gear units are available in single- or 3-phase models. Standard speeds and ratios are 5 4/5:1 to 100:1; output speeds from 17.5 to 302 rpm, and horsepower 1/6 to 5. Units can be mounted in any position. Gears are nickel bronze. Ball bearings are neoprene sealed. Shafts are ground alloy steel. Motors are drip-



proof, totally enclosed, or fan-cooled.

Bulletin B250 giving sizes, ratings and prices on single- and 3-phase models will be sent on request. Write on your company's letterhead.

Abart Gear & Machine Co, 4828-36 W 16th St, Chicago 50, Ill.

CENTRIFUGAL PUMPS P860

Designed to permit mounting pump on any motor with NEMA Type "C" mounting flange, these pumps are vertical and horizontal types, each in 25 standard sizes. Capacities range up to 220 gpm; heads up to 165 ft; motors ¼ to 7½ hp; speeds 1750 and 3500 rpm, maximum total pres-

For further data on above items use reply cards on page192a, identifying your request with letter *P* and number

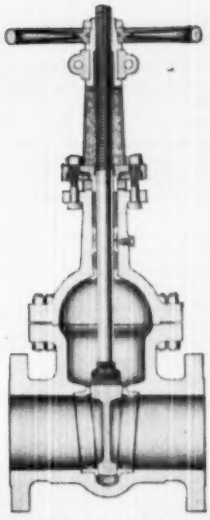
For completeness of selection You can't beat the CRANE line

STEEL VALVES FOR POWER PIPING SERVICES

Crane Cast Steel Wedge Gate Valves find wide application wherever exceptionally rugged and durable steel valves are required. Body and bonnet have heavy metal sections and ample reinforcements at points under greatest stress. Straight-through ports assure minimum turbulence, erosion, and resistance to flow.

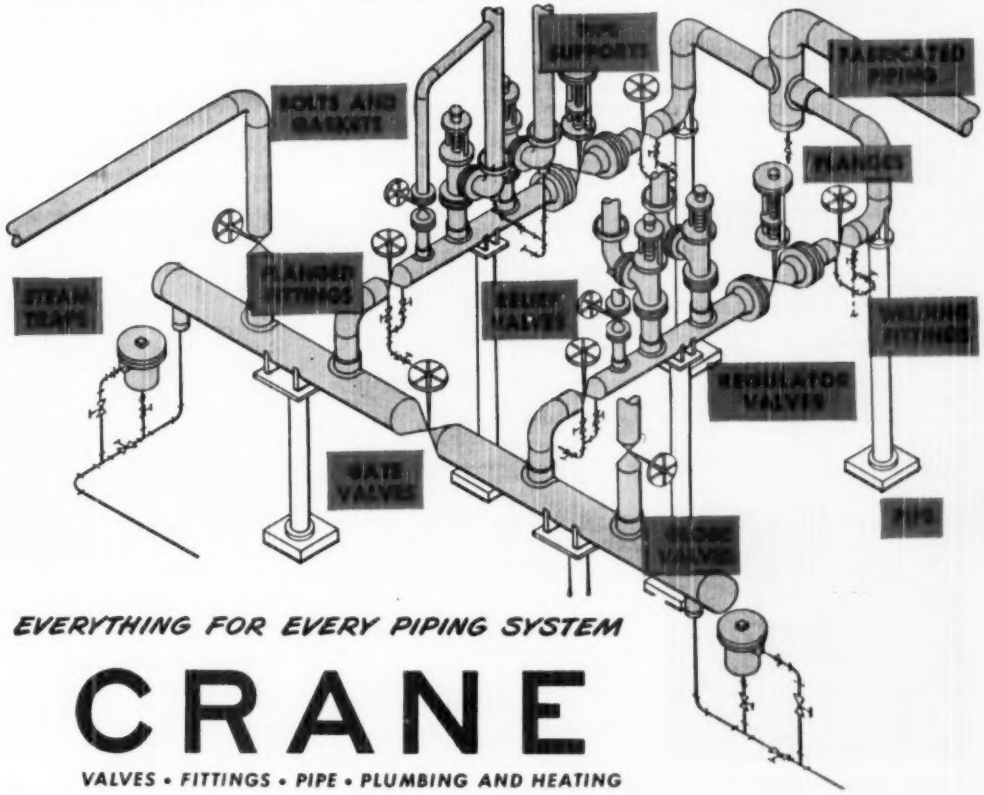
Solid wedge disc with close fitting disc guides maintains accurate seating on shoulder-type screwed-in body seat rings. "T-head" disc-stem connection prevents side strain on stem. Available in pressure classes from 150 to 1500 pounds with a variety of trim materials especially suited for recommended services. Flanged or welding ends up to 24 in.; screwed ends up to 4 in. See your new No. 49 Crane Catalog, p. 226-232.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving ALL Industrial Areas



No. 33XR, 300-Pound Steel Gate for steam up to 850° F.; for water, oil, air or gas up to 500° F. Exalloy to Nickel Alloy seating. Sizes: 1½ to 24 in.

ONE ORDER TO CRANE COVERS ALL PIPING EQUIPMENT FOR THIS PRESSURE REDUCER STATION, FOR EXAMPLE



EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

EQUIPMENT NEWS—CONTINUED

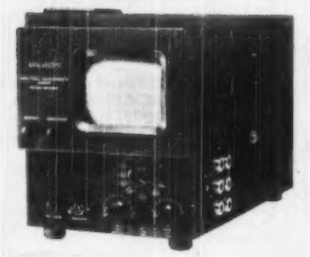
sure 125 lb, suction pressure 50 psi, and maximum recommended liquid temperature 200 F.

Standard packing box head is interchangeable with mechanical-shaft-seal head. Ample space between stuffing-box head and pump shaft coupling permits easy repack.

Pump shaft is stainless steel, fitted with compression coupling to assure alignment of rotating parts. Impeller is enclosed type with nonoverloading characteristic, statically and dynamically balanced and fastened to tapered shaft.

Complete construction details, metal specifications, performance data and related information is contained in illustrated bulletin No. 4350.

Deming Co, Salem, Ohio.

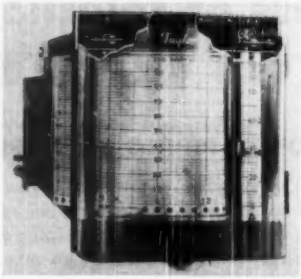


GENERAL-PURPOSE INSTRUMENT **P843**

ANALASCOPE measures and shows on its screen any phenomena that can be translated into electrical impulses. This device eliminates custom building by researchers. The instrument is of general utility in the laboratory since at one moment it serves as a pH meter that measure to .001 pH, and at the next moment it serves as an electrocardiograph, a pressure indicator, a strain analyzer, or, in fact, an instrument for measuring any phenomena converted into electrical impulses, whether static, rapidly fluctuating, or of high or low impedance.

Results are displayed on the long persistence screen of a 5-in. cathode-ray tube.

Analytical Measurements, Inc, 585 Main St, Chatham, N. J.



RECORDING RECEIVER **P817**

Miniature recording receiving instrument, the *Transet*, permits pneumatic transmission of flow, liquid level, pressure and temperature. It gives process information at a central point in a record form similar to the one plotted by an engineer.

Taylor Instrument Co's, 95 Ames St, Rochester 1, N. Y.

FIREPROOF DOOR **P846**

Although it resembles a conventional flush-type wood door, *Kaylo* insulated carries a one-hour fire rating. Fire resistance is provided by a core of lightweight inorganic insulation. This core material, with a normal density of 20 lb per cu ft, allows manufacture of a standard size (3 ft, 4 in. x 7 ft) firedoor weighs only 90 lb.

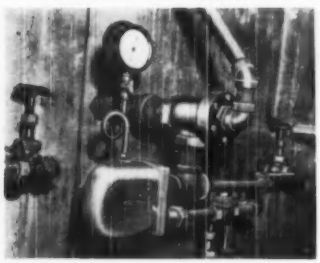
Wood veneer bonded to core results in a door that does not shrink or swell in any season or climate. Furthermore, it is resistant to moisture, rock, or termites. This fireproof door is designed principally for schools, hotels, hospitals, office buildings, and other public structures.

Owens-Illinois Co, Ohio Bldg, Toledo 1, Ohio.

COMPACT COMPRESSORS **P814**

Gas-engine-driven compressors, the *JVG*, available in three sizes 110, 165 and 220 hp, have 4, 6 and 8 power cylinders respectively with an 8¼-in. bore and a 9-in. stroke. Unit is a small, compact 4-cycle, V-angle design and is the packaged version of the first angle-type, gas-engine-driven compressor originated by the manufacturer in 1932.

Ingersoll-Rand Co, Phillipsburg, N. J.



STEAM CIRCULATOR **P812**

New addition to the company's line of steam specialties, the circulator has been designed to speed up condensate removal and improve heat transfer in platen presses, textile drying-machine heaters, tubular heaters for stills and evaporators. Heart of the circulator is air injector that uses uncondensed steam to induce turbulence in condensate flow. Trap completes system.

Sarco Co, Inc, 350 Fifth Ave, New York 1, N. Y.

(Continued on page 150)

Thumb Back a Few Pages And Check These, Too . . .

Variable-Speed Motor with the gear unit permitting speed ratios of 1 to 10. Motors available in ¼, 1/3, ½, ¾ hp ..... p 158

Waterproof Duct has a steel galvanized enclosure around the standard enclosed duct structure ..... p 158

Meter-Testing Switch designed for control of rotating standards ..... p 160

Oil-Burner Pumps in ¾, 1½, 3 and 5 gpm sizes. Available in either packed-box or mechanical-seal designs with or without relief valve p 160

Emergency Generator that can be belted to a tractor for emergency electric power. Unit has mounted control box and voltmeter ..... p 162

Alkalinity Indicator is used like methyl orange but gives quicker, more accurate analysis even in colored and turbid solutions ..... p 162

Dual-Fuel Engine suitable for either natural gas or diesel fuels. Units available in capacities from 135 to 180 hp. Pilot diesel fuel is used for ignition with the heat of compression igniting the gas-air mixture ..... p 166

Union Gage Valve has double union, connecting to both tank and gage. This permits turning gage at any desired angle and removing it without draining liquid from tank, p 168

Vibration Measurement instrument for measuring static or dynamic displacement traced to eccentricity, axial vibration, bearing clearance, etc ..... p 170

Primary Battery suitable for annunciator systems, elevator signals, communication systems, etc. The 1000 amp-hr model is now in production ..... p 170

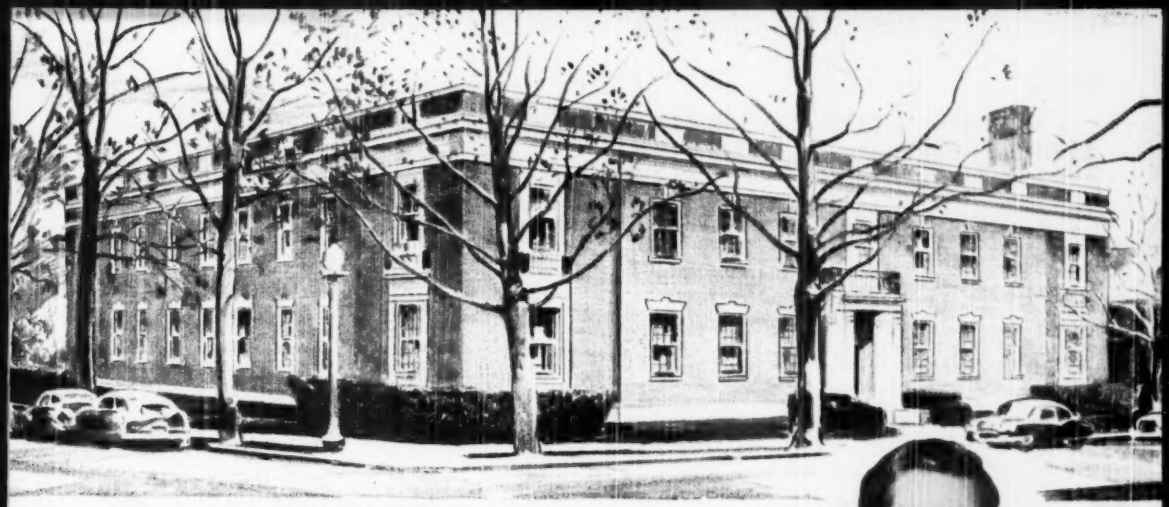
Phase-Sequence Indicator for phasing out new wiring installations before connecting large motors. Just clip on the 3 leads, press the button and note direction of disk rotation ..... p 172

Packaged Boiler from 600 to 6000 lb-per-hr capacity for gas, oil, and combination gas-and-oil firing ..... p 176

And Next Month . . .

Current-Transformer Field-Test Set that quickly checks ct's for shorted turns, high-resistance joints and grounds. Meter has four current ranges: 1.25, 2.5, 5 and 10 amp.

For further data on above items use reply cards on page 192a, identifying your request with letter P and number



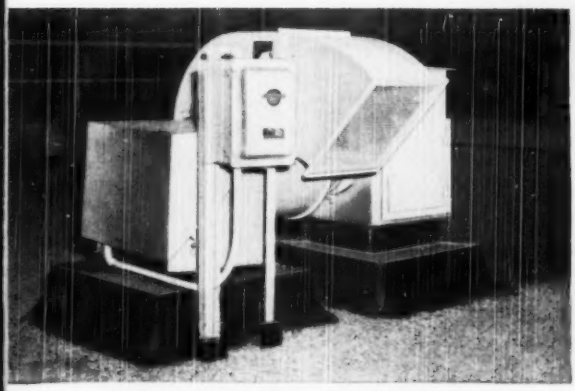
One of the many new exchanges with "Buffalo" air equipment and pumps.

AIR BY "Buffalo"

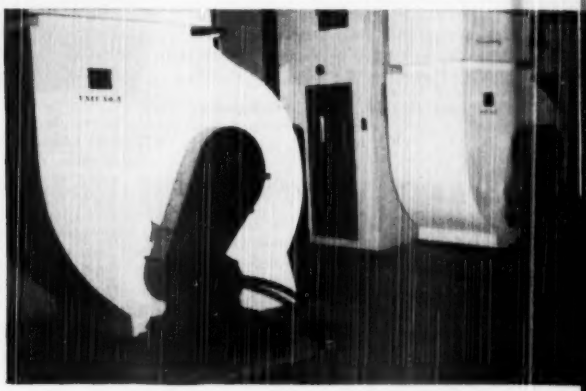
PLAYS A PART IN EXPANDED TELEPHONE SERVICE!

● Better service to more people is the result of a vast expansion program of the Telephone Companies. New buildings and new equipment bring service to many more subscribers—speed up long distance service —make available radio-telephone service.

Many of these new buildings, housing intricate equipment and highly trained personnel, have the finest indoor climate control. Units include "Buffalo" fans, dehumidifiers, comfort conditioning cabinets, "Buffalo" pumps and heaters. Don't take a chance on inferior air equipment in *your* building plans—specify "Buffalo", a leader in the field for seventy-two years.



"Buffalo" Belted Vent Sets Used to Exhaust From Dial Exchange.



"Buffalo" Type "LL" Fans—Air Supply Units insulated to handle refrigerated air.

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont., Branch Offices in all Principal Cities

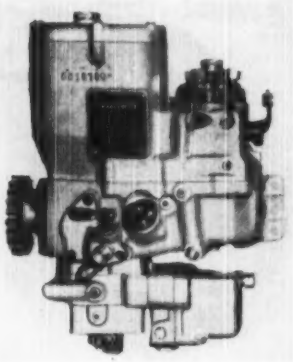
VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

EQUIPMENT NEWS *CONTINUED*

OIL INHIBITOR P847

Transformer insulating oils boast an increased life up to 14-fold when this liquid-foam inhibitor is added. Operating principle evolves around deterring sludge formation. Koppers *Improvol* 20, an active ingredient of this inhibitor, is a chemical compound di-tert-butyl-para cresol.

Koppers Co, Inc, Pittsburgh 19, Pa.



DIESEL FUEL PUMP P826

Type DD pump for certain sizes of Cummins engines is 65% lighter and 56% smaller. Unit is now standard in some 275, 300, 400 and 550 hp engines. Tandem arrangements are used in large engines. Pump is suitable for both stationary and automotive engines.

Pump design permits replacing fuel pressure pumps, distributor disks and governor assembly without removal from engine. Alignment in servicing is minimized by use of a single housing for all parts.

Cummins Engine Co, Inc, Columbus, Ind.

SMALL USER'S AFTERCOOLER P805

Small user of compressed air can now get an aftercooler, the V-907, in two sizes, 30 in. over-all (see above) to cool up to 20 cu ft free air per min, cfam or 48 in. over-all to handle 30 to 50 cfapm. Air-inlet and -outlet pipe sizes up to 1 in. may be specified for both units.

Jas A Murphy & Co, Inc, 5th and Vine St, Hamilton, Ohio

RELIEF VALVE P813

Completely automatic reseating temperature- and pressure-relief valve, the *Tempo*, includes a bellow assembly entirely up and out of the water. The new valve is available in several types and specifications.

A W Cash Valve Mfg Corp, Wabash and Morgan, Decatur 60, Ill.

TEFC MOTOR P840

Featuring a finned-tube air-to-air heat exchanger for cooling these large *totally enclosed, fan-cooled* motors up to 4000 hp. Finned heat exchanger is a single rectangular unit on top of the welded-steel motor frame. Fan draws cooling air from outside the motor, through the tubes, and out front of motor enclosure. Air within the motor is passed over the finned tubes, cooled and recirculated.

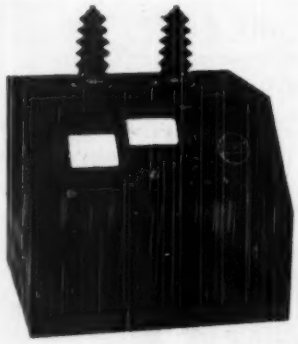
By removing a single faceplate all cooling tubes are exposed for cleaning or inspection. They can be cleaned by fastening a wire brush or tube cleaner through them. And if repair or replacement is required, the entire heat-exchanger unit can be drawn out from the motor enclosure.

Elliott Co, Jeannette, Pa.

FILTER OILER P816

New washing and oiling machine, the Far-Air Utility Oiler, services viscous impingement panel-type air filters. Filters up to 20x28x4 in. are put in the unit for washing and then resurfacing with a viscous oil.

Farr Co, Los Angeles 43, Calif.



HIGH-VOLTAGE TESTER P828

Semi-portable *Hypot* insulation breakdown testing equipment with test-voltage ranges up to 30 kv, ac, with capacities to 1.65 kva. High-voltage output is controlled by a simple pushbutton in the transformer primary, and output is variable from zero to maximum. Breakdown or short circuit in equipment being tested will trip a high-voltage cutout.

Instruments are housed in steel sloping-panel case measuring 20 in. wide, 16 in. deep, 16 in. high. As safety features, voltmeter and test pilot light are behind heavy glass. Ground clip and lead are furnished to keep the case and controls at ground potential.

Associated Research, Inc, 3755 W. Belmont Ave, Chicago 18, Ill.

SELENIUM RECTIFIER P829

Oil-immersed rectifier designed for electroplating. Hermetically sealed selenium stacks are designed to withstand corrosive atmospheres found in plating rooms. Two available models are rated 6/12 v, 1500/750 amp, with the primary ac rating at 230/460 v, 60-cycle, 3-phase. Second model has a secondary voltage rating of 9/18 v, 1500/750 amp, with the same primary ac voltage rating as Model 1.

Complete unit consists of a transformer, fan, 12 rectifier stacks each hermetically sealed in an oil-filled can. Top-mounted fan blows air downward, first over rectifier and then over the transformer, giving the rectifiers benefit of the coolest air. Transformer primary may be connected for 230- or 460-v circuits.

General Electric Co, Schenectady 5, N. Y.

PROCESS TIMER P835

CYCL-FLEX provides four load-circuit combinations. Device mounts in a 3 3/16-in. dia hole for flush mounting in control panels. Typical applications include electronic-heating equipment, molding machines, chemical processing, and similar equipment.

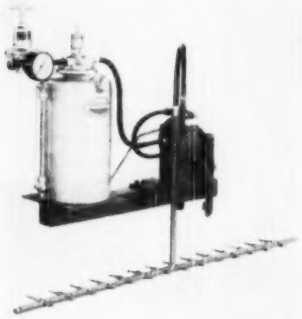
Timer is rated at 10 amp, 110 v, and is available for 60-, 50- and 25-cycle frequencies at 110 and 200 v. Time scales are available from 0-30 sec to 0-10 hr.

Eagle Signal Corp, Moline, Ill.

STEAM TRAP P819

Stainless steel body in place of cold-rolled-steel cadmium-plated body provides additional resistance to abrasive wear and corrosion for the impulse steam trap. Body is Type 416 stainless steel and internal parts are selected stainless alloys.

Yarnall-Waring Co, Mermaid Lane, Philadelphia 18, Pa.



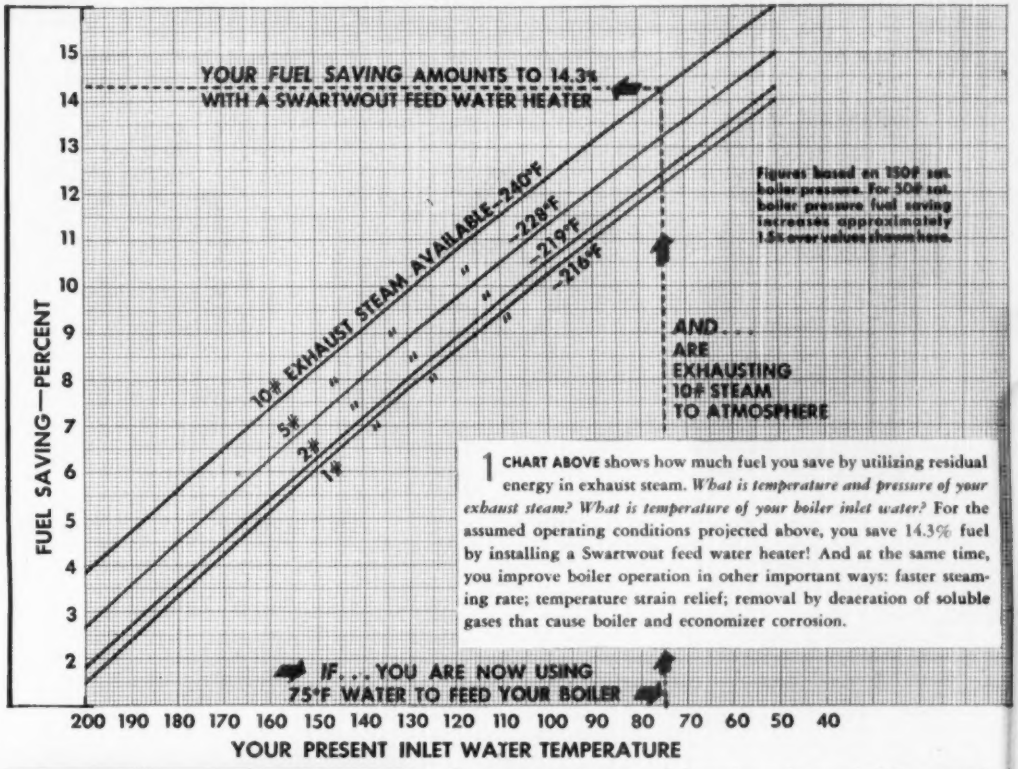
CONVEYOR LUBRICATOR P831

An automatic device with many outlets for lubricating chain-link-pin trolley wheels. Unit's manifold has 14 outlets, 2⅝ in. apart, to lubricate the chain-link-pins that are relatively closely placed. Trolley wheels are lubricated by nozzles attached to the tripping mechanism and directed straight downward.

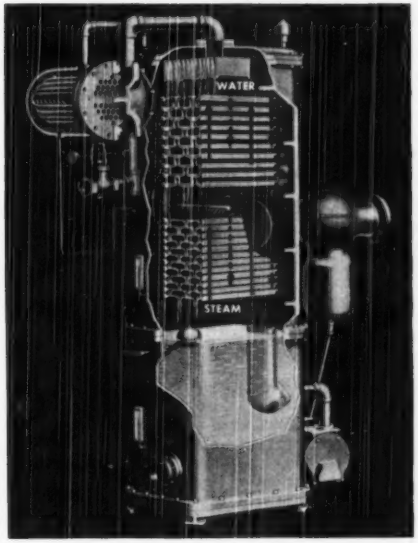
Oil reservoir consists of a 2-gallon con-

For further data on above items use reply cards on page 192a, identifying your request with letter P and number

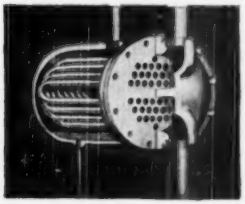
Use exhaust steam! Swartwout feed water heaters save 1% fuel for every 11° temperature rise



1 CHART ABOVE shows how much fuel you save by utilizing residual energy in exhaust steam. *What is temperature and pressure of your exhaust steam? What is temperature of your boiler inlet water?* For the assumed operating conditions projected above, you save 14.3% fuel by installing a Swartwout feed water heater! And at the same time, you improve boiler operation in other important ways: faster steaming rate; temperature strain relief; removal by deaeration of soluble gases that cause boiler and economizer corrosion.



2 COUNTERFLOW heating and deaerating, a feature of all Swartwout feed water heaters, assures efficient removal of contaminating gases. Just before dropping into storage section, feed water is in contact only with clean steam, thereby preventing reabsorption of oxygen. Through counterflow, last traces of oxygen are removed from feed water according to law of partial pressures of gases.



3 VENT CONDENSER is smaller in heaters utilizing counterflow principle. Because less steam does more work, a large condenser is totally unnecessary – important from the standpoint of maintenance economy. Swartwout makes a complete line of deaerating and open heaters –from 5,000 to 300,000 lbs. capacities.

A-2975

Swartwout

POWER PLANT EQUIPMENT

SEND FOR BULLETIN S-18-E • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

EQUIPMENT NEWS—CONTINUED

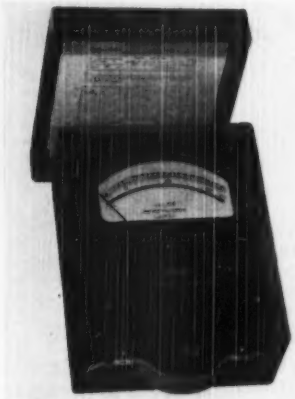
tainer equipped with air regulator and pressure gages. Conveyor speed is 14 to 20 fpm.
J N Fauver Co, Inc, 49 W. Hancock Ave, Detroit 1, Mich.

PLATE MAGNETS P821

New line of nonelectric alnico plate magnets, the *Atomagnets*, come in three models, each with a different magnetic strength, the *Extrapower*, the *Ultrapower*, and the *Superpower* for separation of tramp iron.
Eriez Mfg Co, Erie, Pa.

PORTABLE TACHOMETER P811

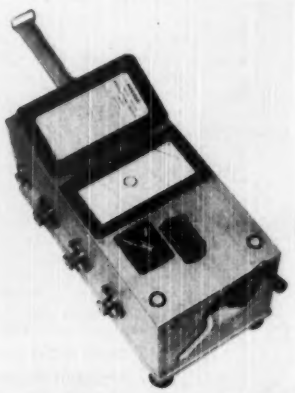
Three-range multiple-scale portable electric tachometer, Model T-101, covers three speed ranges, 0 to 2500, 1000 to 7000, and 1000 to 16000 rpm. Unit including lightweight generator comes in a case.
Electro-Mechano Co, Milwaukee, Wis.



ELECTROSTATIC VOLTMETER P841

These portable and panel-type instruments are designed to measure high voltages where no current can be drawn. Typical applications include measurement of charge of condensers, potential of cathode-ray tubes, ionization chambers, etc.

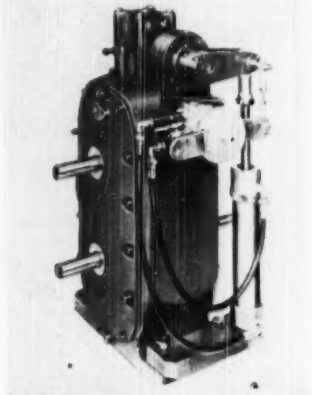
Instruments have double pivoted movements with strong control springs. Mirrored scale is 5 in. long with hand-drawn divisions. Accuracy is 1% of full-scale value. These instruments are designed to measure voltages up to 12,000 v.
Cole Instrument Co, 1320 S. Grand Ave, Los Angeles 15, Calif.



INSULATION TESTER P851

High-range *Megger* insulation resistance tester reading up to 50,000 megohms at 2500 v dc. This instrument is particularly useful in testing circuit-breaker bushings and in making time-resistance (dielectric absorption) tests on apparatus that has relatively high 10-minute resistance values.

This new instrument is also suitable for checking generators, transformers and cables having a relatively high one-minute insulation resistance value.
The James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa.



VARIABLE-SPEED CONTROL P857

Automatic speed controller for variable-speed transmission is available in four types: electronic, hydraulic, penumatic and mechanical. They are used to: (1) keep separate machines in synchronism (2) drive beams, feed rolls, take-ups and pay-off reels at changing infinitely variable speeds to keep constant tension (3) time operating cycles of different lengths precisely (4) hold to narrow limits temperature, velocity pressure, liquid levels and flow of materials.

Variable-speed drives are available with automatic control in eight sizes from 1 to 25 hp for speed ratios of 6 to 1, and in 16 standard types including plain, motorized, single and double reduction, geared for horizontal or vertical mounting.
Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

UNIT CONDITIONERS P807

Coil type, Model C unit conditioner, available in five capacities ranging from 120 to 640 sq ft at 2 lb steam, has a convector-like appearance. One of three distinct coil designs may be selected, standard or nonfreeze for steam, special heating coil for water.
Modine Mfg Co, Racine, Wis.

ROOM CONDITIONER P810

Under-window room air conditioner units come in compact cabinets in three basic sizes. The conditioner cools and dehumidifies summer air, has filters in the path of fresh or recirculated air. Fresh air may be supplied through pipes from a central blower in the basement or from a rear or bottom panel connecting directly to the outdoors through a window or the wall.
McQuay, Inc, Broadway and Johnson St, Minneapolis 13, Minn.

LOW-VOLTAGE SWITCHBOARD P839

Specifically designed for distribution at 600 v and under, this switchboard has a universal frame and six basic components. They are circuit-breaker cell structures, mountings for circuit breakers, rear frames, bottom, top, and bus-supporting members. Flexible feature of the switchboard centers about the square-hole punchings at regular intervals in all six parts. This permits final assembly by bolting with ⅝-in. carriage bolts instead of welding.

This assembly method allows mounting future additions at either end of the structure, or rearrangement of an existing switchboard without factory assistance. Unit is built in two over-all heights: 75⅝ in. and 90⅝ in., including bottom-mounting plate and top cover. Individual cubicles come in 16 sizes ranging from 15 in. high by 16 in. wide and 30 in. deep to 75 in. high by 48 in. wide and 66 in. deep.
Westinghouse Electric Corp, PO Box 2099, Pittsburgh 30, Pa.

DUST COLLECTOR P823

Multiple cyclone-type dust collector has 6-in. tubes in parallel, removes entrained dust and can return clean air to working areas without need of outside discharge. The *Dustex* has a reported efficiency of close to 100% for particles of 12 microns and over with a specific gravity of 2.54 and more.
Duxtex Corp, Buffalo, N. Y.

SILICONE RESINS P834

Two resins for electrical applications. One, No. 81132, is a flexible resin with good drying speed. It is fast-drying without a catalyst and has good heat life. It is intended for use in the coating on glass cloth,

(*Continued on page* 158)

For further data on above items use reply cards on page 192a, identifying your request with letter P and number

EYE-HYEs on your panel— safe, sure check on water levels

Read your boiler water levels easily, quickly, accurately. Read them *conveniently*—right before your eyes, on panel or wall. EYE-HYE Remote Reading Gage is self-illuminated. The bright green indicating fluid duplicates the water in your drum gage. Easily installed, EYE-HYE is simple, safe, sure. It's sensitive to slightest level changes. Has no mechanical parts—is completely hydrostatic. You can blow it down—and should, at intervals, according to instructions. Otherwise, practically no maintenance. Ask other power engineers. Thousands have "repeated"—ordered EYE-HYEs for new boilers, tanks, etc. Write for Bulletin CO or contact nearest Reliance Representative.

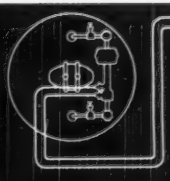
The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

You can use EYE-HYE

—on *low pressures*
(even on a vacuum)

—on *high pressures*
Models available for use on pressures to 2000 psi.

—on *auxiliary vessels*
Heater tanks, flash and storage tanks, waste heat boilers, water treatment systems.



Reliance EYE-HYE
Remote Reading Gage

All-hydrostatic • Reads like a tubular glass gage

ENGINEER'S BOOKSHELF

REVIEWED IN THIS ISSUE

ELECTRICAL METERMAN'S HANDBOOK • MANUAL OF ELECTRIC INSTRUMENTS
KENT'S MECHANICAL ENGINEER'S HANDBOOK, 2 VOLUMES
CHEMICAL ENGINEERS' HANDBOOK • PRACTICAL REPORT WRITING
WARM-AIR HEATING AND WINTER AIR CONDITIONING
ELECTRICAL MACHINES, DIRECT CURRENT AND ALTERNATING CURRENT
ELECTRICAL FUNDAMENTALS, CIRCUITS AND MACHINES FOR ENGINEERS
SCIENTIFIC AND TECHNICAL ABBREVIATIONS, SIGNS AND SYMBOLS
ELECTRONICS, PRINCIPLES AND APPLICATIONS
SALES ENGINEERING • SIMPLIFIED ELECTRICITY FOR UTILITY WORKERS

Electrical Machines

ELECTRICAL MACHINES, DIRECT CURRENT AND ALTERNATING CURRENT (1950). *By Charles S Siskind, assistant professor of electrical engineering, Purdue University.* 521 *pp*, 6x9, 311 *illust*, 13 *tables, cloth.* $4.75. *McGraw-Hill Book Co*, 330 *W 42nd St, New York* 18, *N. Y.*

This book interests practical operators even though written for a junior college text. It won 2nd McGraw-Hill Award for Textbooks in Junior College Technical-Terminal Education. About every type of modern electrical equipment, such as generators, motors, transformers, converters and control are treated in detail. Principles of operation and circuits are carefully studied, but emphasis is also on applications.

Discussions are slanted toward the practical operator and many examples illustrate modern operating practice. The simple, direct mathematical treatment is used only when it clarifies the subject. Carefully worked out examples and illustrations emphasize significant points. Circuit diagrams and photographs are tied in with text.

Many questions and problems at end of each chapter greatly increase the book's usefulness, and serve to drive home the subjects. Every topic and formula is accompanied by practical problems closely following the text. Students will appreciate the answers to these in the back of the book.

Mechanical Engineering

KENT'S MECHANICAL ENGINEERS' HANDBOOK (*12th edition*), *two volumes. Power volume,* 1409 *pp, edited by J K Salisbury. Design and production volume,* 1611 *pp, edited by Colin Carmichael. Both volumes* 6x8½, *illust and indexed; each volume* $8.50, *sold separately. John Wiley & Sons,* 440-*4th Ave, New York* 16.

Power volume covers air, fuels, heat, steam, pumps, piping, boilers, turbines, condensers, refrigeration, heating, ventilation, air conditioning, transportation, electric and atomic power, instruments, test codes and mathematical tables.

About 80 authorities contribute new and original material for the 20 sections. Size is increased about 20%.

Steam engines, gas producers and other less active subjects have not received as much space as previously. Instead, less widely understood subjects, like atomic power, gas turbines, supersonics, jet propulsion, heat pumps and panel heating, get more space. All important phases of the power field are considered.

Power engineers will find this 12th edition a handy reference for basic engineering data and design practice. Throughout this volume, major emphasis is on design, selection and application of power apparatus. Operating methods are but briefly discussed.

Design and production volume is written primarily for engineers who design and manufacture machinery, appliances, mechanical equipment and other engineered products. It interests engineers engaged in production of power apparatus.

Ninety-two contributors have prepared 28 sections, covering selection of materials, design principles, machine components, production processes, plant equipment, mathematical tables. Like the power volume, it is almost completely rewritten.

Report Writing

PRACTICAL REPORT WRITING, *by Selby S Santmyers,* 118 *pp,* 6x9 *in., cloth,* $2.75. *International Textbook Co, Scranton* 9, *Pa.*

Most engineers run into the job of writing a report at some time or other. For many, it's a pretty regular thing. Whether you write reports rarely or often, you'll do a better job after reading this concise book. It covers all types, from brief reports about some current problem in the plant to extensive ones dealing with some major project. You'll like it, and profit by it, because it lives up to the title—it's really practical.

After showing the importance of reports and what they mean to the men who write them, the author leads you through the preliminary steps—gathering material, sorting it out, planning the report and getting ready to write. Then he tells you about the "anatomy" of a good report: its several parts and how they fit together. With that under your belt, you're ready to tackle each part in detail. And by the way, the author has some sound things to say about the mechanics of writing—words and how to put them together.

Sales Engineering

SALES ENGINEERING (*2nd edition,* 1950). *By Bernard Lester, Lester, Hankins & Silver, management engineers,* 226 *pp,* 5⅜ x8⅜, *cloth,* $3. *John Wiley & Sons, Inc,* 440 *Fourth Ave, New York* 16, *N. Y.*

Many of the surveys on employment opportunities for graduating students point up the fact that a number of fields where manpower was once in demand are now faced with a surplus of available talent. But sales in general and sales engineering in particular still need competent people.

Because the sales engineer's work is so often misunderstood or not understood at all, this book aims to give him the appreciation he deserves. What's more, it sheds light on two major subjects: (1) character of sales engineering and opportunities it affords (2) ways to develop an intelligent, skilled sales performance. Both subjects are of vital interest to the recent graduate and of value to the man out selling.

This edition is rearranged, and in many instances text is expanded. Several practical examples of new methods are added.

Chemical Engineering

CHEMICAL ENGINEERS' HANDBOOK (*revised, 3rd edition*). *Edited by John H Perry.* 1942 *pp,* 7½x10 *in.,* $15. *McGraw-Hill Book Co,* 330 *W 42nd St, New York* 18, *N. Y.*

More than a hundred specialists in various phases of chemical engineering contribute to this fully revised and expanded edition. Divided into 30 sections, book starts with mathematical tables and runs through to safety and fire protection.

Subjects include flow of fluids, heat transmission, drying, mechanical separations, process control, fuels, furnaces and kilns, power generation, refrigeration, plant location, electrical engineering, safety and fire protection. Comprehensive formulas, equations, charts, tables and schematic diagrams cover a broad range.

All major progress during prewar, war and postwar years is included. New, larger page size permits more and better illustrations, with larger tabulations of data. Index is particularly helpful because it contains not only common reference words but also their synonyms and equivalents.

Like past editions, this should prove a useful addition to power engineers' book shelves, particularly in process industries.

Simplified Electricity

SIMPLIFIED ELECTRICITY FOR UTILITY WORKERS. *By P R Rutledge. Series of* 10 *booklets in loose-leaf binder,* 246 *pp,* 9x11, $10.20, *Delmar Publishers Inc, Albany* 1, *N. Y.*

This series has been developed as the basis of a training course for electric utility employes who lack a technical education. Each booklet or unit includes instructional

(*Continued on page* 178)

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

Refinery "Q" said: "Can you clean heat exchangers fast?"

Dowell Service cleaned seven heat exchangers in 19 hours!

This refinery had 7 heat exchangers that were badly fouled. Minimum downtime for cleaning was a prerequisite to maintain production. Dowell Service removed 80% of the deposits from the process sides in only 19 hours. As a result the operating pressure drop through the system was lowered from 80 p.s.i. to 5 p.s.i. with an equally satisfactory drop in operating temperatures.

Dowell Service is the answer to the maintenance engineer's demand for *fast, efficient, economical* cleaning. Maintenance time and costs can be cut by applying Dowell Service to condensers, process towers, boilers . . . to nearly any type of industrial equipment. Dowell engineers fill the equipment to be cleaned with liquid solvents. These solvents are designed to clean places inaccessible to other methods. Costly dismantling is eliminated and downtime is shortened.

What's *your* cleaning problem? Dowell Service Engineers will be glad to consult with you on *better, faster* methods of cleaning your equipment. No obligation, of course. Dowell Service is as near as your telephone.

Other recent Dowell jobs:

Oil, water, algae emulsion removed from refinery circulating water system in only 6 hours.

•

Water side of 15 tube and shell condensers cleaned for refinery. After Dowell Service, gasoline left condenser 20° cooler than when condensers were mechanically cleaned. Chief engineer estimates Dowell Service paid for itself in approximately 12½ days.

•

Partially carbonized oil and grease caused trouble in five 150,000 lb. hr. boilers in a Southwestern refinery. Dowell Service removed the deposits from each boiler in a few hours.

CALL

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

New York 20	Buffalo 2	Kansas City 8	Mt. Pleasant, Mich.
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Baltimore 18	Detroit 2	Houston 2	Salem, Illinois
Wilmington 99	Chicago 2	New Orleans 12	Borger, Texas
Richmond 19	St. Louis 8	Ft. Worth 2	Midland, Texas
Jacksonville	Indianapolis	Shreveport 69	Wichita Falls, Texas
Atlanta	Louisville	Anniston, Alabama	Lafayette, La.

Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

A SERVICE ORGANIZATION

Be an 'Active' Member

While cleaning out the attic the other day I ran across an old 1920 issue of POWER. Thumbing through it I found an interesting item. Since most of us belong to some association, be it an engineering society, church group, labor union, fraternal lodge or political club, I thought I'd pass it along without comment. Here it is:

TEN WAYS TO KILL AN ASSOCIATION

1 Don't come to the meetings.

2 But if you do come, come late.

3 If the weather doesn't suit you, don't think of coming.

4 If you don't attend, find fault with the work of the officers and other members.

5 Never accept an office, as it is easier to criticize than to do things.

6 Nevertheless, get sore if you are not appointed on a committee, but if you are, don't attend the committee meetings.

7 If asked by the chairman to give your opinion regarding some important matter, tell him you have nothing to say. After the meeting tell everyone how things ought to be done.

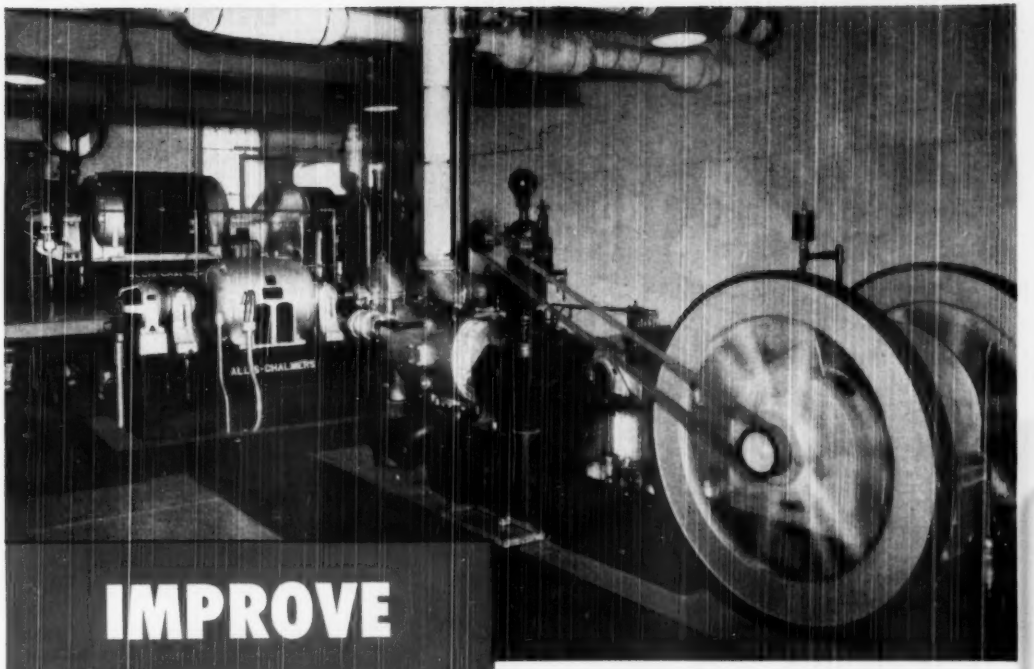
8 Do nothing more than is absolutely necessary, but when other members roll up their sleeves and willingly, unselfishly use their ability to help matters along, howl that the association is run by a clique.

9 Hold back your dues as long as possible, or don't pay at all.

10 Don't bother about getting new members, let the other fellow do it.

George Edwards

Engineer



IMPROVE STEAM ENGINE PERFORMANCE

AND reduce wear by using the proper TEXACO STEAM CYLINDER OIL

Steam engines—old or new—run better when lubricated with Texaco steam cylinder oils designed to meet the particular operating conditions. Operators everywhere have found this so.

You'll find the Texaco steam cylinder oils recommended for your engines will atomize completely, and protect pistons and cylinders from wear by keeping them coated with a tough lubricating film. There are oils that resist wash-off under wet steam conditions; others that stand up under the highest temperatures. You'll be sure of steam-tight rings and properly functioning valves . . . greater efficiency all around.

If you use your steam for processing, you can get Texaco steam cylinder oils especially designed to separate rapidly from exhaust or condensate.

Call in a Texaco Lubrication Engineer. He'll gladly help you select the proper lubricants to improve your steam engine performance. Contact the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Steam Cylinder Oils

FOR EVERY OPERATING CONDITION

What Other Drive Gives You...
1 UTMOST FLEXIBILITY
Sustained high torque from starting to maximum speed — that's typical of the exceptional flexibility that can be achieved with Troy Steam Engines. Speed can be varied smoothly, quickly, without complex auxiliaries. Or constant speed can be maintained with the Type EN Governor — which can be instantly adjusted manually or automatically over a speed range as great as 6 to 1!
plus
2 SIMPLICITY, LONG LIFE
3 ACCURATE, FAST SPEED CONTROL
4 BY-PRODUCT POWER
5 HIGH STARTING TORQUE

From floating on the line to full steaming: Wide speed range and smooth power, combined with year-after-year dependability, make a Troy Steam Engine the logical drive for a chain grate stoker, as in this installation at Children's Memorial Hospital, Chicago.

WHICH DO *YOU* NEED?

If your drive needs any or all of these five characteristics, the *modern* Troy Steam Engine is indicated. Send us your drive requirements and steam conditions, and our engineers will be glad to recommend the right type and size Troy engine to meet your needs.

Send for Bulletin 306

TROY

Troy Engine & Machine Co.

Power Equipment Division

2504 RAILROAD AVENUE • TROY, PENNSYLVANIA

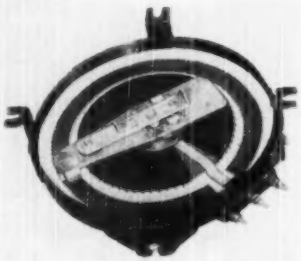
EQUIPMENT NEWS

(*Continued from page 152*)

glass sleeving, and as a sticker for mica-glass tape and other flexible mica products. It is supplied as a 60% solution in toluol.

Second resin, No. 81145, is applied as a 50% solution of petroleum spirits. It was designed for bonding and impregnating motors, generators and transformers requiring Class H insulation. It may be used, however, in bonded mica, mica tape, and glass combinations.

Chemical Dept, General Electric Co, Pittsfield, Mass.



LAMP DIMMERS P838

Although designed primarily for lamp dimming in connection with lighting control in theaters, auditoriums, schools, etc. *Radiastats* are equally suitable for industrial or laboratory use where ac voltage must be adjusted. Unit is essentially an autotransformer that can control any lamp load from 5 watts minimum to the maximum rated wattage. These maximum load ratings are 5500 and 8000 watts in the two available sizes. Both units are designed for 110-120 v, 50-60-cycle service.

Ward Leonard Co, Mt. Vernon, N. Y.

VARIABLE-SPEED MOTOR P830

Fractional horsepower unit combining in one unit a *Varidrive* and a heavy-duty *Syncrogear* for increasing torque. Geared unit permits interchange of speed in a ratio of 1 to 10. Motors are available in ¼, 1/3, ½ and ¾ hp output.

Available speed ranges are from 10 to 10,000 rpm. Dial control permits instant speed change by turning handle less than one revolution. Slippage is prevented by a belt tensioner to automatically compensate for varying load.

U. S. Electrical Motors, Inc, 200 E. Slauson Ave, Los Angeles 54, Calif.

WATERPROOF DUCT P832

Low-reactance feed-in duct of waterproof design. This UL-approved design embodies a complete galvanealed steel enclosure around the standard compact duct structure. Suitable drip hoods are provided and the enclosure lap joints are positioned to keep out rain or dripping water. Duct may be installed in horizontal as well as vertical runs.

Bus bars are separated and totally enclosed by solid sheets of nonabsorptive, arc-

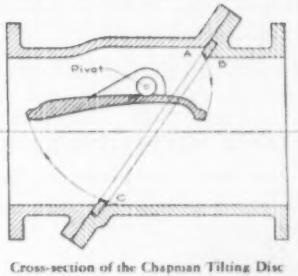
For Quick, Quiet Closing...

USE CHAPMAN *Tilting Disc* CHECK VALVES

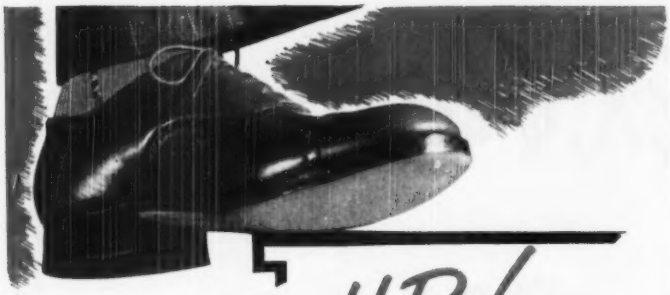
You get truly cushioned closing with these tilting-disc check valves. There's no slamming. Instead, the disc rides smoothly on the flow, opens easily, closes quickly and quietly. Because of this effortless action, power costs are lower (when used on pump discharge lines) . . . maintenance costs are lower . . . operating expenses are saved in a dozen ways.

Available in either iron or steel. Write for bulletin with complete information.

The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASS.



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.



STEP-UP!

DRAINAGE CAPACITY WITH

Clark DUO-STEP Leverage STEAM TRAPS

Get the DOUBLE-LIFT that doubles steam trap efficiency!

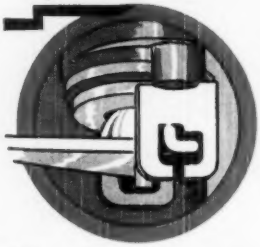
● It pays to be curious about the efficiency of the steam traps you are using. Are you getting the value you *can* and *should* get in terms of drainage capacity? Or are you paying a premium for the capacity you require?

Clark DUO-STEP is a *new* idea. It actually gives Clark Steam Traps *double* the drainage *capacity* of old-fashioned traps of equal size. And that means *double value!*

Find out about DUO-STEP *today*—and save the difference!

THE CLARK MANUFACTURING CO.
1831 East 38th St. • Cleveland 14, Ohio

Step 1 cracks the orifice



Step 2 opens orifice completely

Send for the story on Clark DUO-STEP Leverage *today!*

DUO-STEP Leverage

Clark FLUID CONTROLS

resistant insulating material. Complete assembly is clamped and bolted together on 24-in. centers to provide maximum structural strength for resisting short-circuit stresses in excess of 50,000 amp. This weatherproof feed-in duct is available in ratings from 600 to 4000 amp, 600 v or less.

Square D Co, PO Box 272, Roosevelt Park Annex, Detroit 32, Mich.

METER-TESTING SWITCH P837

Potential switch designed for control of rotating standards. Relatively low pressure, about 6 oz, is required to move the pushbutton through its total travel length, which is less than 3/22 in.

Manufacturer claims life expectancy of the switch should be between 5,000,000 and 10,000,000 operations under normal conditions. Unit's silver contacts are rated at 10 amp, 240 v, ac. The 11/32-in. hole in switch case accommodates 2-conductor No. 16 Type SJ cord. Bulletin No. 810 carries complete information.

The Eastern Specialty Co, 3617 N. 8th St, Philadelphia 40, Pa.

OIL-BURNER PUMPS P858

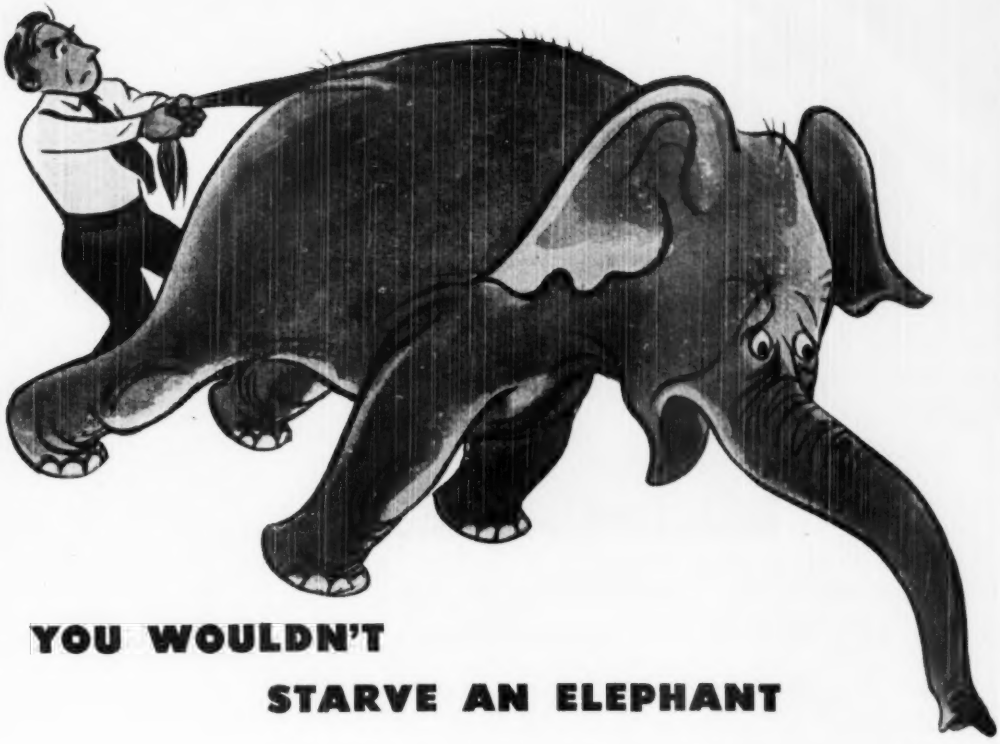
Built in ¾, 1½, 3 and 5 gpm sizes, the pumps have been tested and approved for oil-burner service by Underwriters' Laboratories, Inc. They are available in either the packed-box or mechanical-seal designs, with or without relief valve. The ¾, 1¼ and 3 gpm sizes are flange mounted, while the 5-gpm size is foot mounted.

Geo D Roper Corp, Rockford, Ill.

ROTARY PUMPS P862

Designed for pumping petroleum products and other light or viscous fluids in volumes to 85 gpm against pressures up to 150 psi, as required for rotary and steam-atomizing oil burners, oil-transfer, lubrication, hydraulic systems and similar service.

They have only three working parts, a power rotor and a pair of sealing or idler rotors which mesh with the power rotor to convey continuously from inlet to outlet.



YOU WOULDN'T STARVE AN ELEPHANT

...TO SAVE PEANUTS!

No, and it's just as unsound to risk loss of valuable machinery and production for the sake of saving "peanuts" on initial oil costs. For lubrication is not just "oils and greases" . . . it's also knowledge of machinery, the right lubricants to use, and where and how to use them.

That's why you save so many ways with Socony-Vacuum *Correct Lubrication* . . . a custom-made program of lubrication for your plant that pays off in greater output per machine, less friction loss, lower maintenance costs, and—ultimately—lower lubrication costs.

For the *genuine* savings of Correct Lubrication, call your Socony-Vacuum Representative.

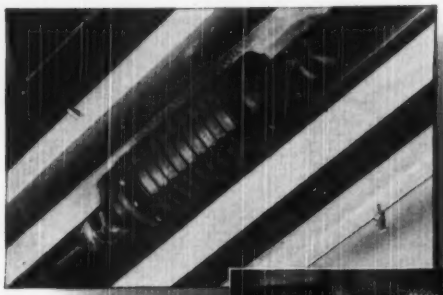
SOCONY-VACUUM

Correct Lubrication

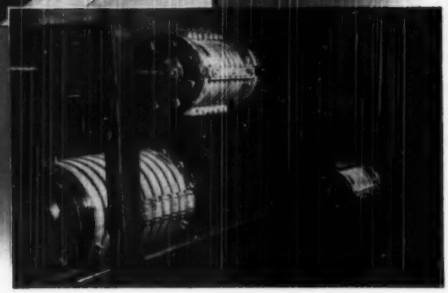
WORLD'S GREATEST LUBRICATION KNOWLEDGE AND ENGINEERING SERVICE

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION

NO MAINTENANCE HERE!



An ADSCO Corruflex Joint installed in overhead steam line in a large industrial plant.



Three of the joints in tunnel piping at large state hospital.

Install ADSCO *Corruflex* PACKLESS EXPANSION JOINTS and FORGET MAINTENANCE in hard-to-reach spots!

It costs too much to service a joint thirty feet in the air or jammed in a small tunnel — and there's no need for it. ADSCO *Corruflex* Packless Expansion Joints never require packing. They need no maintenance. There are no upkeep costs.

Corruflex Joints are on the job all the time . . . absorbing pipeline expansion and contraction . . . protecting lines and equipment from undue strain.

And ADSCO *Corruflex* Joints are easy to install. Their compactness — with a maximum outside diameter scarcely larger than that of an ordinary flange — makes them ideal for use overhead or in trenches, tunnels or other cramped quarters where installation costs may be unusually high.

Like other ADSCO products, *Corruflex* Joints are built to the highest standards. They are available in sizes from 3" to 24", single or double units, single or multiple corrugations, with or without self-equalizing rings, and with flanged or welding ends. They are supplied in copper, stainless steel or other alloys and with internal sleeves if required.

Corruflex Joints have traverses ranging from fractions of an inch to 15" and operate under pressures from vacuum to 300 psi and temperatures from sub-zero to 1600 F.

For dimensions and further information, consult your ADSCO representative or send us your requirements for our recommendation. For descriptive literature, *write for Bulletin No.* Z-35-51.

For an impartial recommendation, ask the company that makes all types of expansion joints . . . ASK ADSCO.

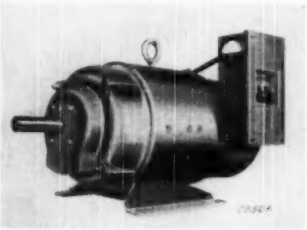
ADSCO

Leaders Since 1877

EXPANSION JOINTS — HEAT EXCHANGERS
STEAM TRAPS — STRAINERS — METERS
CASING — ANCHORS — GUIDES

AMERICAN DISTRICT STEAM CO
NORTH TONAWANDA, N. Y.

Can be direct-connected to electric motors, turbines or other high-speed drivers without reduction gearing, belts or chains. Pump can be mounted in any position and suction may be at top, bottom, horizontal left or horizontal right.
De Laval Steam Turbine Co, Trenton 2, N. J.



EMERGENCY GENERATOR P853

Tractor owners can have their own low-cost emergency electric power by belting this 60-cycle generator to their present tractor. Unit is available in 3000-, 5000- and 10,000-watt capacities. Unit features a mounted control box with an ac voltmeter, permitting adjustment of generator speed to correct voltage. A protective circuit breaker is included to guard against overload damage.
D W Onan & Sons, Inc, 3623 Royalston Minneapolis 5, Minn.

HEADREST GOGGLES P871

New, easily adjustable headrest goggles are said to be perfectly balanced with no overhanging weight. They may be obtained with either *Noviweld* or *Noviweld-Didymium* lenses.
American Optical Co, Southbridge, Mass.

AIR COOLER P872

Evaporative cooler, the *De-Hu-Matic*, has five evaporation zones that enable regulation of evaporation regardless of outside humidity.
U. S. Air Conditioning Corp, Minneapolis, Minn.

ALKALINITY INDICATOR P873

New total-alkalinity indicator, used exactly like methyl orange, has the same endpoint but gives quicker, more accurate analysis even in colored and turbid solutions.

Indicator is green when in alkaline solutions. Just before reaching the endpoint the greenish color changes to gray, and at the endpoint to purple.
Power Chemicals Div, E F Drew & Co, Inc, 15 E 26th St, New York 10, N. Y.

STUFFING-BOX PACKING P874

New cone-type packing for stuffing-box service, *Chemiseal* No. 810C, made entirely of *Teflon* is chemically inert, withstands temperatures from 150 to 550 F.
United States Gasket Co, PO Box 93, Camden, N. J.

PLASTIC PACKING P875

Nonjacketed packing, *Versi-pak*, comes in two formulas: black, graphited for gen-

JUST SAY

OIC

FOR

For any valving requirement, you can specify OIC Valves and be sure of efficient, precise control. That's because OIC Valves are:

PRECISION ENGINEERED—positive closure . . . minimum friction . . . designed for smooth, free flow of air, gases and liquids.

PRECISION BUILT—every essential part accurately finished for a precise fit, on the most modern production equipment.

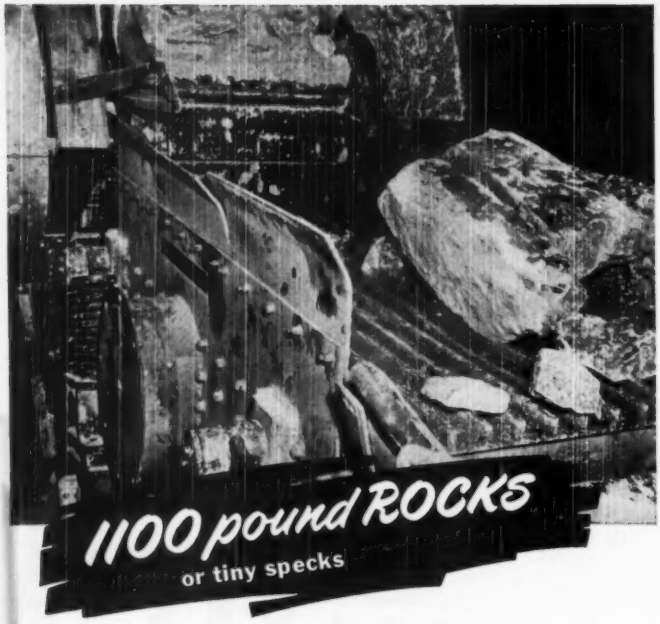
PRECISION APPLIED—OIC engineers always available to help you select valves best suited to each job, at lowest cost.

Here's a three-way combination that provides "*precision valve*" *equipment* in your plant. First costs and upkeep costs are lower. See your local OIC distributor, or write us direct. Ask for a free copy of the 1950 OIC Valve Cross-Reference Chart. The Ohio Injector Company, Wadsworth, Ohio.

OIC
FOUNDED 1883

VALVES

FORGED AND CAST STEEL · IRON · BRONZE



. . . Hewitt-Robins Vibrating Screens Process Them All!

Take a look at that big brute of a machine. It's a vibrating screen—a Hewitt-Robins Heavy Duty Scalper.

The big rock you see on its deck is a 3 x 2 x 1½ lump of ore weighing about 1100 pounds. The Scalper handles loads like this at 1000 tons an hour. Yet, it absorbs those loads—and its own vibration—so completely that a coin placed on edge on the base beams will stand up without toppling over *while the machine is running!*

The same company that makes this big brute also makes a small screen called a Ceramic Slip Lawn. This lawn is so precise in action, so effective in operation, that it finds and removes tiny specks of impurities—about ½ pound in every ton of materia!—from clay slip for pottery plants.

Think of that range—from 1100 lb. rocks to tiny specks! It's the best proof of all that Hewitt-Robins can satisfy *your* vibrating screen demands!

Just look at these facts: Hewitt-Robins originated the circle-throw principle for vibrating screens. Hewitt-Robins created the elliptical throw. Hewitt-Robins pioneered in both 4-bearing and 2-bearing vibrators. Hewitt-Robins introduced the full-floating principle of vibration-absorption.

Whatever you want in vibrating screen equipment, you can *safely* rely on Hewitt-Robins. Tell us your needs; we will supply the answer. Write to Robins Conveyors Division, 270 Passaic Avenue, Passaic, N. J.

HEWITT-ROBINS
VIBRATING SCREENS

HEWITT-ROBINS HR **INCORPORATED**

BELT CONVEYORS *(belting and machinery)* • BELT AND BUCKET ELEVATORS
CAR SHAKEOUTS • DEWATERIZERS • FEEDERS • FOAM RUBBER PRODUCTS
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eral service; white, nongraphited for food handling and other special services, and in sizes from ⅛ to 1 inch in 1/16-inch increments, spiral or butt-cut rings. It has greater density than woven or braided packings, is more resilient than die-formed types.

Packing Div, Raybestos-Manhattan, Inc, Manheim, Pa.

PRESSURE-RELEASE BOLTS P876

Safety-release pressure bolt prevents opening of oil burners, strainers, pressure vessels during operation. Bolt works from pressure within the vessel.

A hole through the bolt body brings fluid under pressure to a piston in the bolt head. This moves the handle bar and holds it in the out-of-bolt turning position so any movement of the bar in this position has no effect on the bolt. Once pressure comes off, handle bar goes back to bolt-turning position so the bolt can be taken out.

Thos C Wilson, Inc, 21-11 44th Ave, Long Island City 1, N. Y.

TEST BLENDER P877

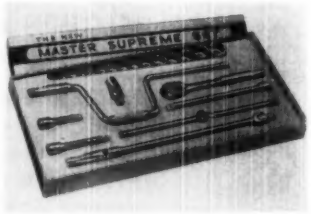
Heavy, transparent platsic-shell bodies of test-size blender are mounted in an adjustable cast-aluminum base to allow interchange of twin-shell blender sizes. Unit comes in 4 and 8-qt capacities and gives efficient blending results for laboratory purposes.

Patterson-Kelley Co, Inc, 56 Burson St, East Stroudsburg, Pa.

HYDRAULIC CUTTER P878

Portable, 45-lb, quick-cutting, hydraulic cutter, the *Guillotine*, has an open "C" frame anvil. Any source of compressed-air at 100 psi applied through an air-hydraulic pump unit operates the cutter. Cutting power is rated at 22½-ton thrust. Basic unit can also work with either an electric-hydraulic pump or a separate, manually operated one.

Manco Mfg Co, Bradley, Ill.



SOCKET WRENCH SET P852

Master Supreme Set consists of 15 double hexagon sockets ranging in sizes from 7/16 in. to 1¼ in., a 10-in. ratchet, 18-in. nut spinner, 15-in. sliding bar, 18¾-in. speeder, universal joint, and 3½-, 5- and 10-in. extension bars.

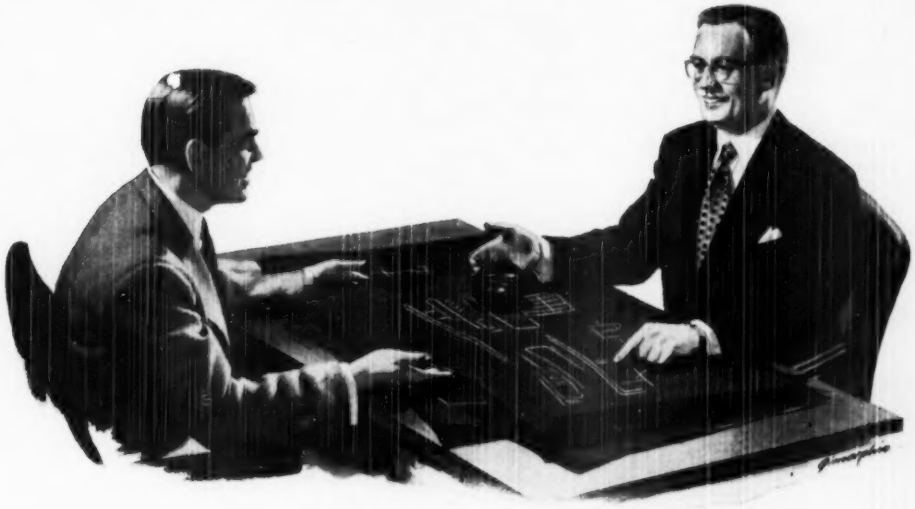
Snap-On Tools Corp, Kenosha, Wis.

TERMINAL CRIMPER P836

Along with cutting, stripping, and bolt-shearing fittings, the *AMP* hand tool, No. 49835, has jaws for crimping solderless terminals. Tool is designed to attach a

Study fuel costs at long range...

then power your plant with B&O Bituminous Coals



Power plant design and operation present few problems to an industrial engineer. But, truly economical performance rests on *added knowledge*—of reserves and availability of fuels—of their cost relationships and combustion characteristics.

In planning the operation of your power plant, study the value of bituminous. Check production cost at the mines. Look at delivered cost of Btu's. Study how carefully the coal you order is sized and cleaned so that waste is avoided. Check availability of continuous supply in normal times and in emergencies. Find out if reserves are extensive enough to assure future supply.

In the coals produced on the Baltimore & Ohio, *you'll find the right answers* to low-cost, long-range supply. Whether you need high-, medium-, or low-volatile coals, they're here in abundance. *Ask our man!* He shall be glad to supply technical help on every phase of coal production, preparation, distribution, and utilization.

BITUMINOUS COALS FOR EVERY PURPOSE
—FROM MODERN MINES
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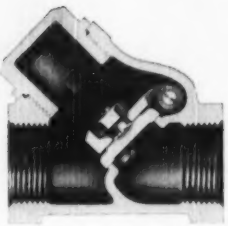
BALTIMORE & OHIO RAILROAD

Constantly *doing things*—better!

When a valve must make its own decisions use KENNEDY Swing Check Valves

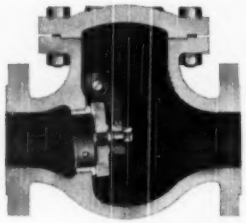
A swing check valve often guards the most vital point in your lines. That is why you will want the full assurance of KENNEDY'S seventy-three years of valve experience back of the check valves you select. When things are flowing smoothly . . . in the right direction . . . it stays open with minimum flow resistance. The moment back pressure develops it closes instantly and positively!

KENNEDY manufactures check valves in a wide range of types and sizes. Write for full details.



KENNEDY FIG. 492—BRONZE SWING CHECK VALVE

Steam 300 lbs. at 550° F. Cold Water, Oil or Gas, Non-shock, 600 lbs. Generous diameter cap permits easy inspection and regrinding without removing from line. Swing disc swivels in hinge while a stop on the cap prevents sticking in open position. Sizes ½" to 3".

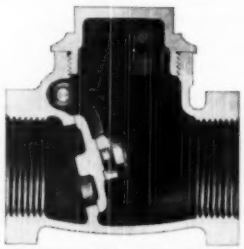


KENNEDY FIG. 889—IRON BODY BRONZE MOUNTED

Bronze Faced Disc. Steam 250 lbs. at 500° F. Cold Water, Oil or Gas, Non-shock, 500 lbs. Revolving disc is self-adjusting. Angular placement permits easy opening at low pressures while also reducing closing shock at high back pressures. Sizes 2" to 10".

KENNEDY FIG. 106—IRON-BODY SWING CHECK VALVE

Flanged; Bronze Mounted, Bronze Faced Disc. 2" to 12" Saturated Steam 125 lbs. Cold Water, Oil or Gas, Non-shock, 175 lbs. Has revolving, self-adjusting disc angled for easy opening at low pressure and shock reducing closing at high back pressure. Sizes 2" to 24".



KENNEDY FIG. 103—BRONZE SWING CHECK VALVE

Bronze or Leather-Faced Disc. Saturated steam 125 lbs. Cold Water, Non-shock, 200 lbs. Also recommended for use on oil and gas lines. Leather-Faced disc should be used on cold water lines. Easy swinging disc is hinged on bronze pin . . . will not stick in open position. Sizes ¼" to 4".

BUY FROM YOUR LOCAL DISTRIBUTOR

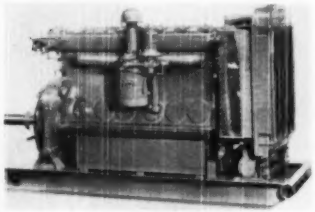
THE **KENNEDY** VALVE MFG. CO.
1060 EAST WATER ST.
ELMIRA, NEW YORK
VALVES • PIPE FITTINGS • FIRE HYDRANTS

OFFICE-WAREHOUSES IN NEW YORK, CHICAGO, SAN FRANCISCO • SALES REPRESENTATIVES IN PRINCIPAL CITIES

special line of general-use terminals and connectors known as *WIRE-ENDS* to wire in sizes from No. 22 to No. 10.

Tool is designed to prepare the wire beforehand because of its wire-cutting and wire-stripping features. Bolt-shearing feature eliminates need for additional filing before the sheared bolt is used. Useful wire-size and stud-size gages are engraved in tool's side.

Aircraft-Marine Products, Inc, 1601 N. Front St, Harrisburg, Pa.



DUAL-FUEL ENGINES **P825**

Suitable for either natural gas or diesel fuels these units are available in capacities from 135 to 180 hp. They are heavy-duty units using high compression. Gas fuel is fed to engine through air cleaner and intake manifold. Gas valve is controlled by hydraulic governor.

Changeover to either fuel is made by positioning a lever. Pilot diesel fuel is used for ignition, heat of compression igniting gas-air mixture. Constant small quantity of pilot fuel is used.

Murphy Diesel Co, 5317 W. Burnham St, Milwaukee 14, Wis.

PORTABLE WELDER **P802**

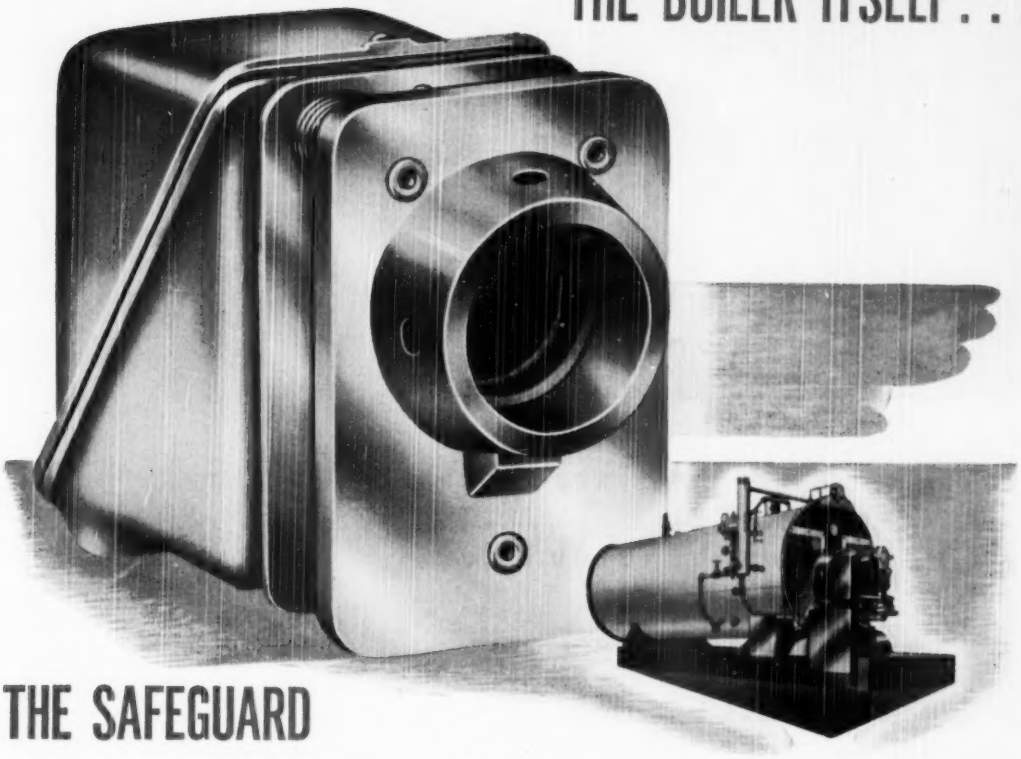
Silicone-insulated, portable, ac welder, the 6WK20H, is compact, 12x17-in. cross section by 23 in. high. It weighs 154 lb, has a current range from 30 to 250 amp, accommodates electrodes from 1/16- to 3/16-in. dia.

General Electric Co, 1 River Road, Schenectady, N. Y.

OZONE LAMP **P856**

Glass bulb, less than 1½ in. in dia, gives out small concentrations of ozone that are

MORE IMPORTANT THAN THE BOILER ITSELF . . .



THE SAFEGUARD THAT PROTECTS IT

FACTORY MUTUAL FM APPROVED UL

*W*here the safety of personnel and property are vital, and where uninterrupted plant operation must be assured; Fireye Flame Failure Safeguards are certain to be specified.

Fireye insures complete flame failure protection because it is photo-electric . . . it sees the flame . . . and if flame fails, Fireye acts with the speed of light to cut off the supply of fuel *before* dangerous gases accumulate in the combustion chamber.

Controls which do not react instantly can not provide full protection . . . for it is the few seconds of delay between flame failure and fuel shutoff which charge the combustion chamber with potential destruction.

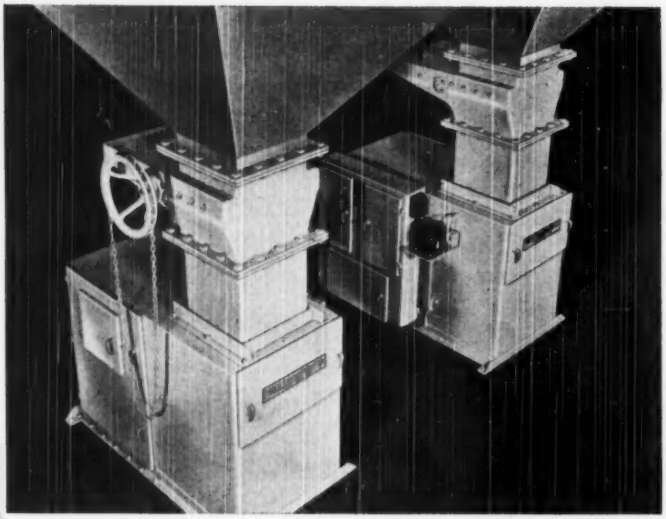
Fireye more than meets the exacting requirements of all insurance laboratories for the protection of *all* classes of oil and gas burners . . . that is why Fireye is standard with leading burner manufacturers.

To insure complete protection for your plant and personnel, write for Bulletin 604-E

fireye

COMBUSTION CONTROL CORP.

77 BROADWAY, CAMBRIDGE 42, MASS

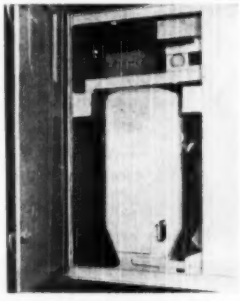


LOW MAINTENANCE COSTS ARE ASSURED

with S-E-CO. COAL SCALES

Large assembly door and feeder access door make it possible to remove the feeder and weigh hopper quickly as units. If the feeder support rails are also removed, the inside of the coal scale body is entirely free of operating parts. The inside of the scale is then clear for cleaning and painting. If this work is done occasionally, the scale body should last indefinitely.

The sub-assembly idea is exclusive with S-E-Co. Coal Scales. This is another reason why these units will give the best coal scale operation.



Send your inquiry to

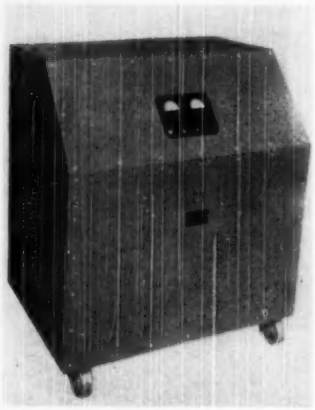
STOCK EQUIPMENT COMPANY

715P Hanna Building ★ Cleveland 15, Ohio

useful in making odors less noticeable. It is used with a ballast in a simple fixture that allows the free escape of ozone but shields the eyes from the ultraviolet energy generated by the lamp. One lamp produces enough ozone to mask odors in areas up to 1000 cu ft.

In addition to household applications, the lamp is suitable for elevators, reception and conference rooms, along with heating, ventilating, and packaged air-conditioning units.

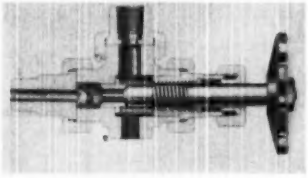
General Electric Co, Nela Park, Cleveland 12, Ohio.



DC-POWER SUPPLY P827

Portable 28-v, 150-amp, dc supply whose output voltage can be adjusted within a 10% range. Supply voltage is 208/120 v, 3-phase, 4-wire. Ripple is limited to 1% maximum rms.

Sorensen & Co, Inc, 375 Fairfield Ave, Stamford, Conn.



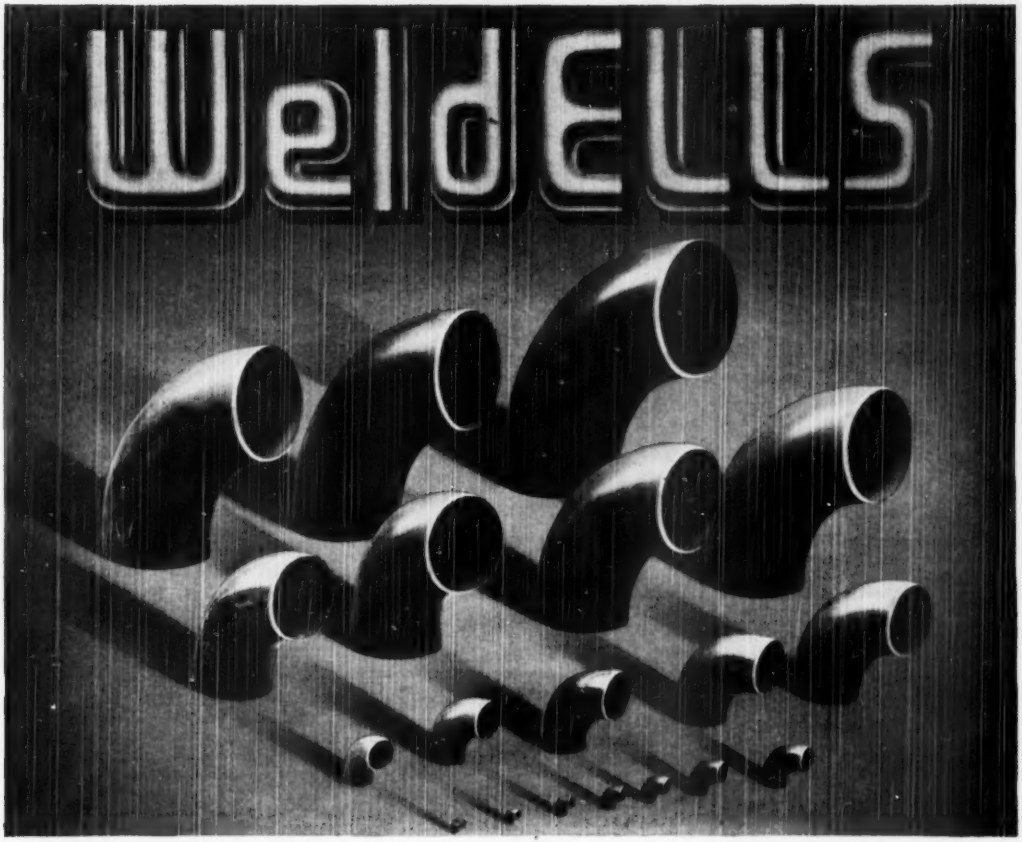
UNION GAGE VALVES P806

Double-union on new line of gage valve connects to both gage and tank or vessel and permits turning gage at any desired angle, or removing it without draining liquid from the vessel or pulling out the valve. New valves include two offset ones, No. 66-U and No. 46-U and a steam-jacketed globe model, the No. 93-U.

Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass.

GEARED POWER DRIVES P861

These splashproof motors are built with single- or double-reduction gears, providing speeds from 780 rpm down to 20 rpm, in ratings ½ to 5 hp. One-piece cast-iron stator frames and one-piece-cast end bells



Family Group . . . *proud of its size . . . and traditions*

Large group though it is, you see here only one branch of the world's largest family of fittings for pipe welding.

It is simply the stock sizes of long-radius WeldELLS in a single weight and material — merely a small fraction of the enormous line that includes more types of fittings, in more materials, more weights and more sizes than any other line.

Important though the breadth of the WeldELL line is to every man who designs or erects piping, still more important is the significant fact that the WeldELL family grew to this size because nothing less could meet the demand for fittings of WeldELL quality and uniformity to satisfy every conceivable piping condition.

Yes, there is a Taylor Forge Fitting for every purpose. From the smallest to the largest, every fitting in the WeldELL line shares the principle of sound engineering design and job-speeding utility that Taylor Forge has consistently applied for half a century.

Mail the coupon for Taylor Forge catalog.

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TAYLOR SPIRAL PIPE is again promptly available in a broad range of sizes and thicknesses. Coupon brings new Spiral Pipe Bulletin 493.

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Offices in all principal cities: *Eastern Plant:* Carnegie, Pa.
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Increased production at a West Coast assembly line caused a parts shortage. Shipment in transit was located at St. Louis in late afternoon and Air Expressed to coast. Delivered 5 A.M. next morning. Speed like this keeps production rolling, lets you meet every delivery date. Shipping charge for 50-lb. carton: $24.56.

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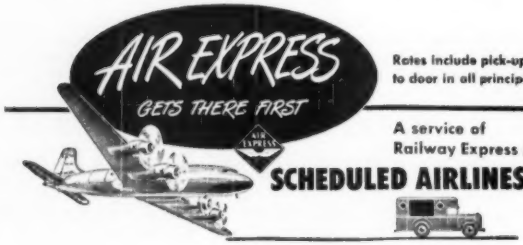

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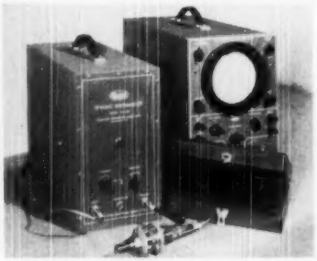
with integrally cast baffles provide protection in all kinds of industrial plants, especially creameries, canneries and chemical-processing plants.

End-bell design permits free passage of ventilating air through the motor and prevents splashed liquids reaching the interior of the motor. Seals are used on shaft ends to protect against liquids getting into the bearing housings.

Sterling Electric Motors, Inc, Telegraph Rd at Atlantic Blvd, Los Angeles, Calif.



VIBRATION MEASUREMENT P845

An accurate instrument for measuring dynamic or static displacement traced to eccentricity, axial vibration, bearing clearance, reciprocating movement, and radial expansion. Where coatings are applied to metal, the dynamic micrometer measures thickness of film. And where repetitive vibration is found (in compressors, pumps, engines, etc) it provides a direct, accurate reading of vibration amplitude and frequency. Instrument consists of a conventional mechanical micrometer head with sensing unit. This device is used in conjunction with a cathode-ray oscillograph. Oscillograph shows displacement versus time curve on the screen, which is an important factor in accurate measurement of acceleration and other phenomena. Sensitivity is equal to 1% of total displacement.

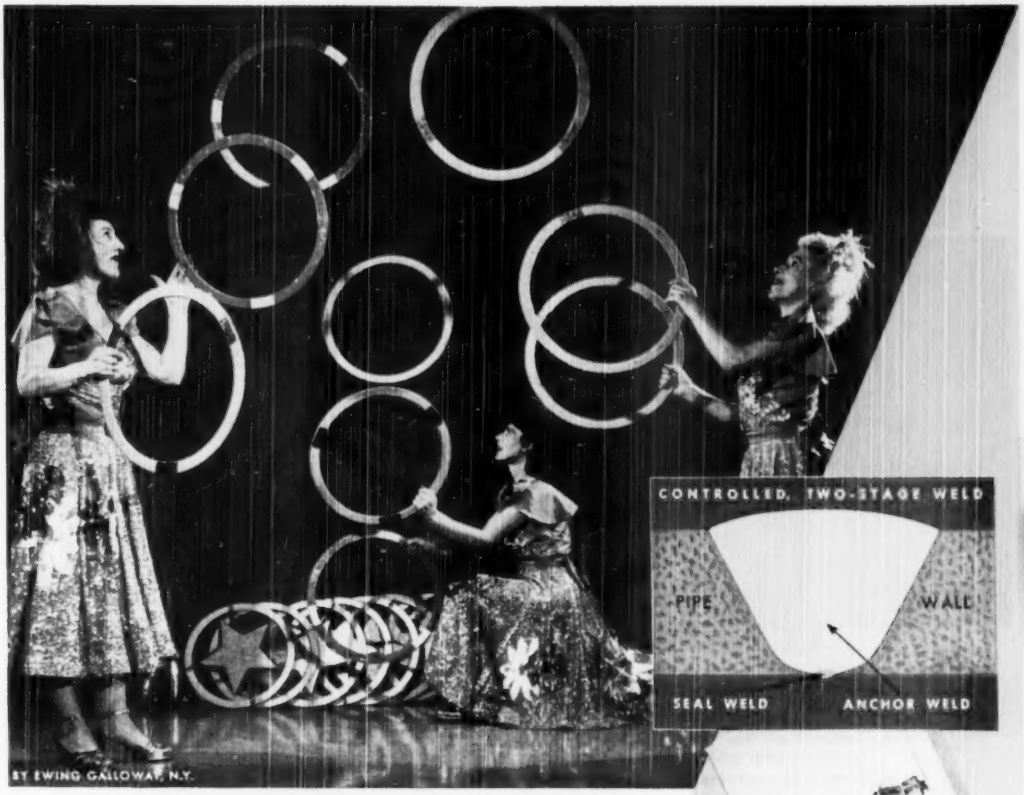
Operating principle evolves about the change in reactance when the sensing-coil high-frequency field meets an external metal body. This change in impedance of the coil introduces a voltage change which is amplified and then introduced to the oscillograph.

Electro Products Laboratories, Inc, 4501 N. Ravenswood Ave, Chicago 40, Ill.

PRIMARY BATTERY P842

Suitable for annunciator systems, elevator signals, communication systems, time-clock operation, and other services that need a reliable, independent source of low-voltage dc. One widespread use will be in converting oil-burning railroad switch lamps to electrical operation. This changeover will eliminate the conventional weekly or twice-weekly servicing. The new *Carbonaire* battery will supply enough electricity to keep a switch-lamp going 10 to 12 months with only occasional inspections.

The 1000-amp-hr model now in production contains two series cells sealed in a single, molded, hard-rubber case. Dimen-



DON'T JUGGLE YOUR PIPING

Juggling is all right for entertainment but it's the last thing you'd want to do with your power piping. Here's what we mean: Without proper facilities, many times you have to juggle each pipe section into position and "make it fit." But that's not the case with our prefabricated piping. Our 50 years' experience, "know-how" and extensive shop facilities enable us to produce a finished job that will meet the most exacting specifications and highest standards of safety. Repeat contracts with some of the largest utilities and industrial plants attest to their complete satisfaction on both large and small jobs. Let us relieve you of all piping details and eliminate the juggling act. Also ask us about the Mitchell-Westport Joint which prevents metal protrusions inside the pipe without the use of backing rings. Our bulletin, "Something New in Welding," explains it. Write for your copy now.

WESTPORT JOINT
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REPRESENTATIVES IN BOSTON, NEW YORK, CLEVELAND, MOBILE AND HAVANA

W. K. MITCHELL & CO., INC.
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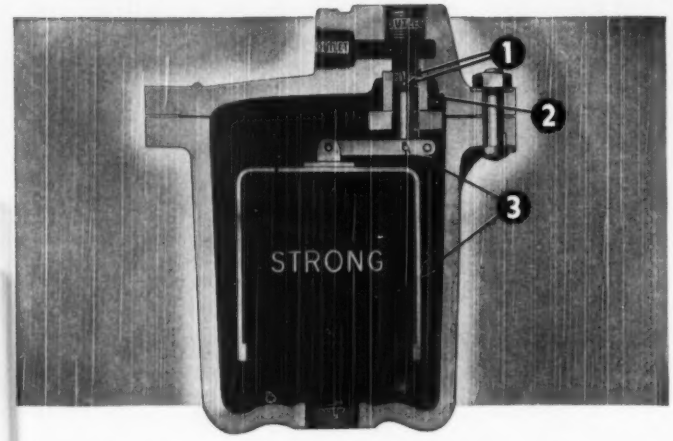
3 Reasons STRONG* Traps are easy to maintain!



Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
2. **Bolted-in seat design—insures tight seal, easy servicing;**
3. **Stainless steel bucket and trim.**

Compare these features with other traps!

STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

Catalog No. 68-P describes inverted, open bucket and other types of STRONG traps. Write today.

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STRONG

sions are 8¼x7¼x9½ in. Like other primary batteries, the *Carbonaire* is not chargeable and must be replaced when expended.

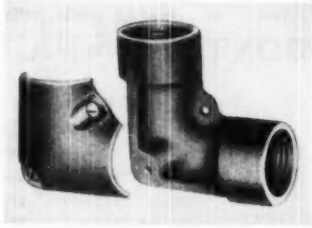
Thomas A Edison Inc, Primary Battery Div, Bloomfield, N. J.

PHASE-SEQUENCE INDICATOR P855

This portable indicator is handy in connection with wiring, installing and testing polyphase circuits and apparatus. To determine phase sequence, it is only necessary to clip on the leads, push the button, see the direction of disk rotation.

Device can be used for checking phase sequence of circuits above 60 cycles by raising minimum circuit voltage above 60. Maximum frequency is 400 cycles. Device can be used to check 180-cycle circuits of 200 v or more.

Electrical Facilities, Inc, 4240 Holden St, Oakland 8, Calif.



CONDUIT PULL-IN ELBOW P833

Fitting allows running conduit around sharp corners without forcing or damaging the wires. It makes sharp right-angle turns possible for straddling beams or for any location requiring a snug corner fit. Removable cover is on elbow's side, allowing use of fitting on either inside or outside corner.

Since cover is large, wires may be pulled in straight, in either direction, when cover is removed. This UL-approved fitting is available in ½, ¾ and 1 in. sizes.

Gedney Electric Co, 1270 Sixth Ave, New York, N. Y.

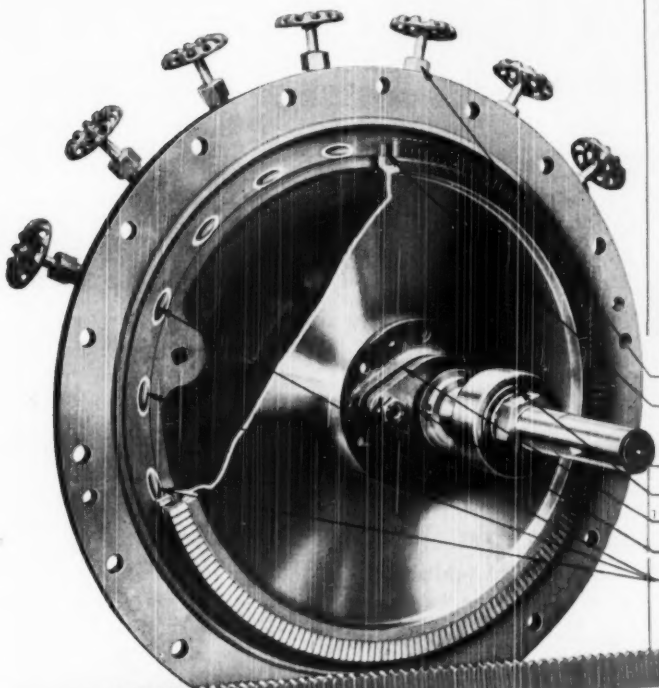
VARIABLE-SPEED TRANSMISSION P863

Used for variable-speed control with fractional-horsepower motors, these transmissions have a speed-locking device that keeps the pulley in the desired speed posi-

No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



7 hand valves for efficient partial load operation, (20" turbine shown)

2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced

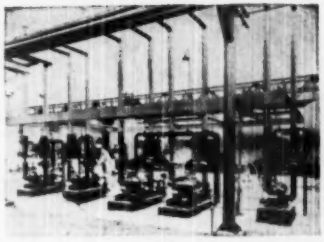
30-40 carbon steel shaft

Oversized double row deep grooved ball bearing

Stuffing box with metallic packing ring

Heavy chrome plating of shaft through stuffing box

3 nozzles always open



Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

MAKE TURBINE DOLLARS GO FARTHER

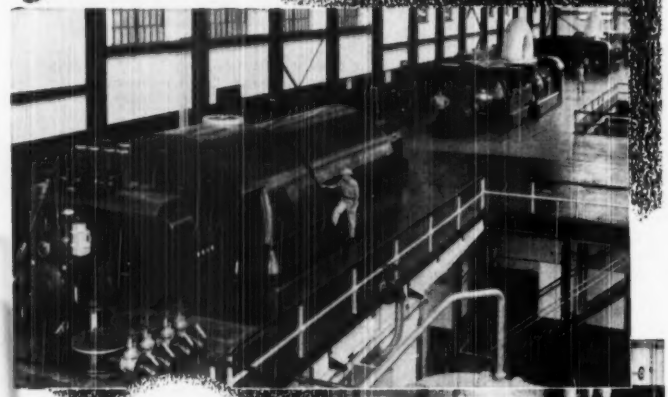
Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 135

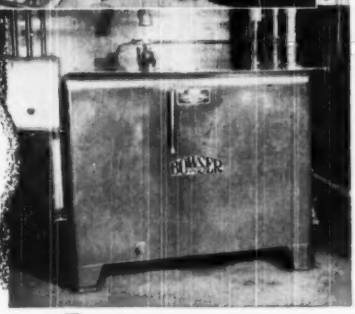
COPPUS ENGINEERING CORP., 168 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

Longer life for Turbine Bearings



The bearings of these 40,000 KW turbine generators are insured against bearing failure by Bowser oil conditioners.



Stop THESE 6 ENEMIES OF TURBINE OIL NOW....

1. Turbulence
2. Air Entrainment
3. Moisture Contact
4. Heat
5. Metallic Contact
6. Removal of Inhibitors

When turbine bearings "stay-on-the-job," costly shutdowns are avoided and less standby equipment is required.

• • •

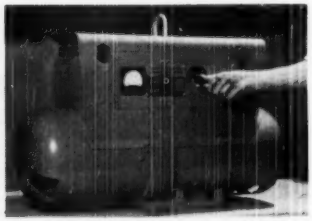
Write today for your copy of this new bulletin on the improved Bowser method for conditioning turbine oils.

BOWSER, INC., 1326 Creighton Avenue, Fort Wayne 2, Ind.

LIQUID CONTROL SPECIALISTS SINCE 1885

tion throughout the entire 3-to-1 ratio. It can be mounted anywhere in any position on the machine and the control placed in the best position for the operator or remote control.

Frazier & Son, 338 Cortlandt St, Belleville, N. J.



TRUCK BATTERY CHARGER P849

Automatic feature of this equipment includes battery cutoff and charger shutdown when battery is fully charged. There is also an automatic disconnect feature of the charger from the power line and opening of the charging circuit in event power is interrupted. Charger automatically restarts when service is resumed, following an interruption. Control of charging rate under the modified-constant-voltage charge is also automatic.

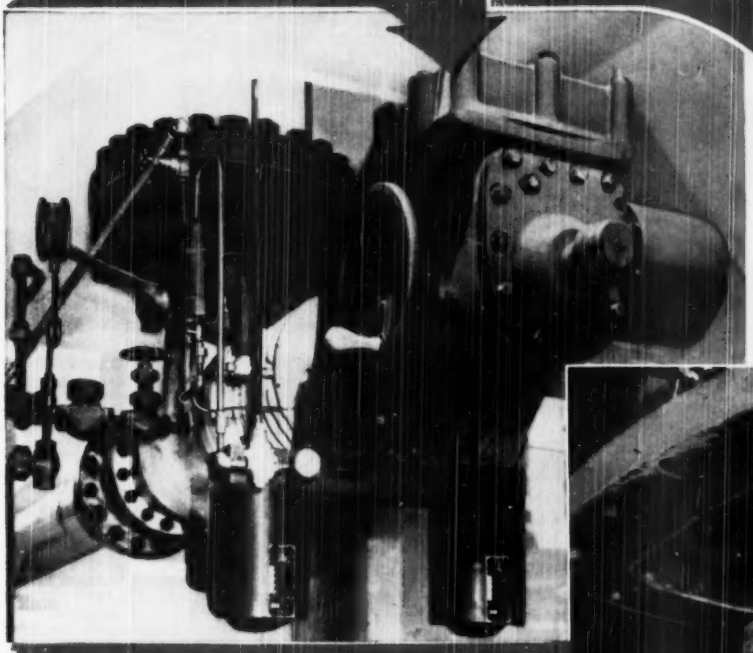
Charger is adaptable to both lead-acid and nickel-iron alkaline batteries. Units operate on 220/440-v 3-phase 60-cycle power supply.

General Electric Co, Schenectady 5, N. Y.

ELECTRIC CHAIN HOIST P859

Totally enclosed with a double worm-gear drive, these hoists use a spring-set shoe-type motor brake. Pull cord is at the center instead of the end of the hoist frame, to eliminate tendency for the hoist to tip when the control cord is pulled. Hoist control switch has been simplified and protected by a new mounting. The switch wiring and motor brake are readily acces-

LIMITORQUE PREVENTS this



Philadelphia LimiTorque Control

LimiTorque Control gives absolute assurance against improper seating, by means of a positive safety overload mechanical torque cut-out. If obstruction is met in closing valve, the torque switch becomes operative and disconnects the motive power.

Philadelphia LimiTorque Control will efficiently open and close globe, gate, butterfly and plug valves etc. by the "push of a button" at a remote or nearby control station. Handwheel is provided for rapid manual operation if necessary.

LimiTorque is readily adapted to any make of valve. Furthermore, it can be installed on existing equipment. Any available power source for operation may be utilized, electricity, oil, gas, water, air. LimiTorque can be supplied by any valve manufacturer.

Send for Catalog. *Our LimiTorque Catalog is yours upon request. Please write on your business letterhead.*

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON

IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

. . . Having trouble with oil in Steam Condensate?

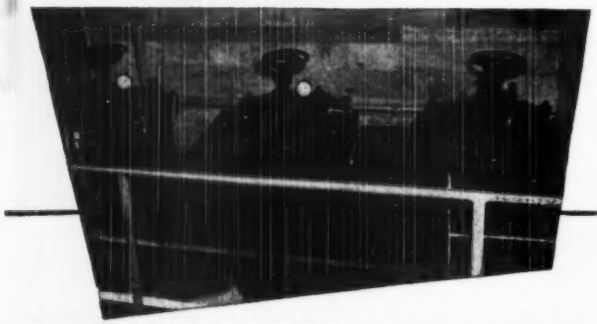
THE SPARKLER PROCESS

. . . reduces oil down to less than .25 p.p.m. in return condensate, the lowest of any commercial process, by employing Sparkler filters, together with other equipment.

This process is engineered to your requirements and our installation service men will be on the job to see that it works to both your and our complete satisfaction.

Write Mr. K. L. Carr, Sparkler Mfg. Co., Mundelein, Illinois for estimate of the cost of an installation for your power plant.

Filters used in one installation of this process that provides a flow rate of 200 gallons per minute.



SPARKLER MANUFACTURING CO.

MUNDELEIN, ILLINOIS

Makers of industrial horizontal plate filters for over a quarter of a century

sible for inspection, adjustment and repair.

Hoists are available in ¼-, ½-, 1- and 2-ton capacities. In the 2-ton model a built-in hook reduces headroom 2½ in.

Whiting Corp, Harvey, Ill.

GRILLE SELECTOR **P822**

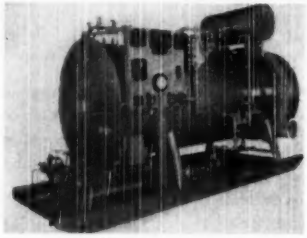
Rapid sizing of ventilating and air-conditioning grilles can be made with the new grille selector supplied by the manufacturer at no cost. Table of maximum allowable noise levels for different installations is printed on ruled face.

Barber-Colman Co, Rockford, Ill.

POCKET SLIDE RULE **P880**

Vest-pocket 5-inch log-log, all-metal slide rule, No. 600, has 22 scales with a new back-to-back scale arrangement. Scale is 1 3/32x6x3/32 inch.

Pickett & Eckel, Inc, 55 Wabash Ave, Chicago 3, Ill.



PACKAGED BOILER **P820**

Redesigned and improved models of the company's *Steam Pak*, packaged boilers, for high- and low-pressure steam from 600- to 6000-lb-per-hr capacity, have been released for gas, oil or combination gas-and-oil firing. Heating components are more closely placed, oil-piping length is cut down and a new method has been incorporated for lubricating the atomizing compressor.

York-Shipley, Inc, York, Pa.

OIL PREHEATER **P809**

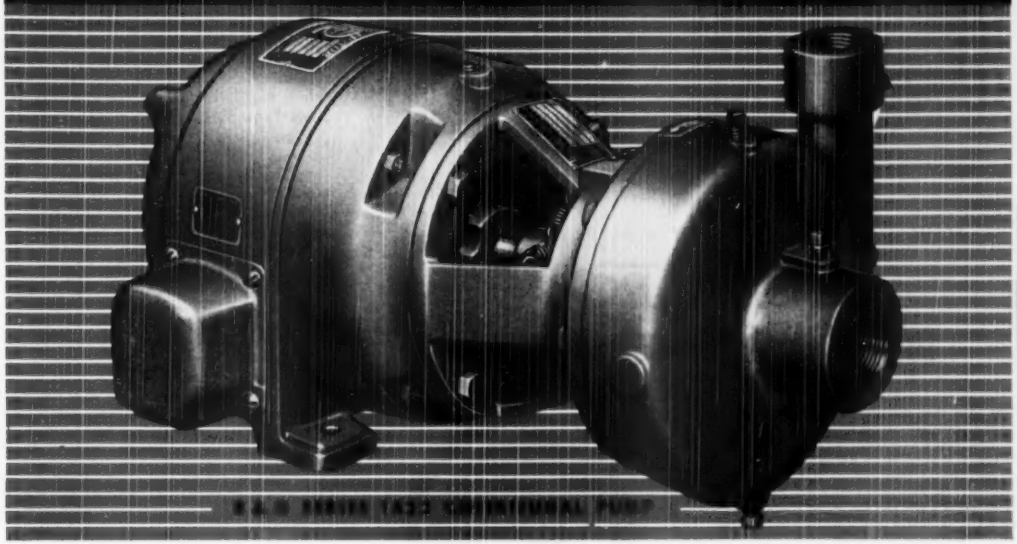
Multi-pass, high-velocity, electric oil preheater provides a fuel of uniform viscosity, free from worries of carbonization of heating surfaces.

Oil heater has flat tubular heating surfaces staggered so oil passes back and forth in a thin stream at high velocity. Heating surface has a low watt density.

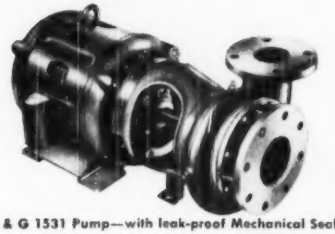
Hynes Div, Martin-Quaid Co, 1893 W. Sedgley Ave., Philadelphia 32, Pa.

1...2...3...4...5...6...7...8 Big Reasons

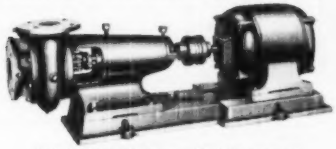
WHY THE B & G 1522 PUMP SHOULD BE YOUR CHOICE FOR TOUGH PUMPING JOBS



MORE PUMP VALUE PER DOLLAR



B & G 1531 Pump—with leak-proof Mechanical Seal



B & G 1510-15 Pump—flexible coupled

Engineers and maintenance men are astonished at the performance of the B & G 1522 Pump . . . because this unit licks the pumping jobs which usually cause trouble. For these reasons—

First: Leak-proof Mechanical Seal—ends stuffing box troubles.

Second: Spring-type flexible coupling—contributes to unusually quiet operation.

Third: Hydraulically balanced impeller.

Fourth: Easily serviced. Removal of a few bolts permits separation into three parts.

Fifth: Interchangeable parts. The bearing bracket subassembly, including shaft and sleeve bearings, is manufactured to close tolerances and is interchangeable in all 1522 Pumps.

Sixth: Shaft alignment maintained by oil lubricated, high grade bronze sleeve bearings.

Seventh: Standard motors—easily obtainable from motor manufacturer's stocks.

Eighth: With all these features B & G 1522 Pumps are *competitively priced!*

Send for Catalog CY-350

B & G

Hydro-Flo* PRODUCTS

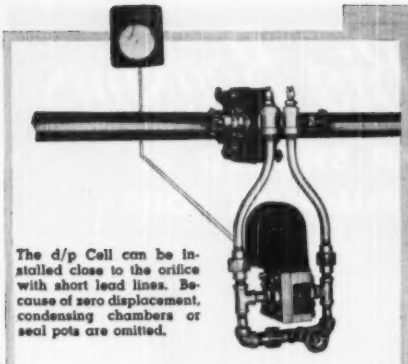
Heat Exchangers . . . Water Heaters . . . Pumps . . .
Refrigeration Equipment . . . Forced Hot Water Heating Systems

BELL & GOSSETT COMPANY

Dept. BR36, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Road, Toronto, Canada

*Reg. U. S. Pat. Off.



The d/p Cell can be installed close to the orifice with short lead lines. Because of zero displacement, condensing chambers or seal pots are omitted.

Simpler Flow Measurement

in the palm of your hand

NEW • REVOLUTIONARY • MERCURY-LESS

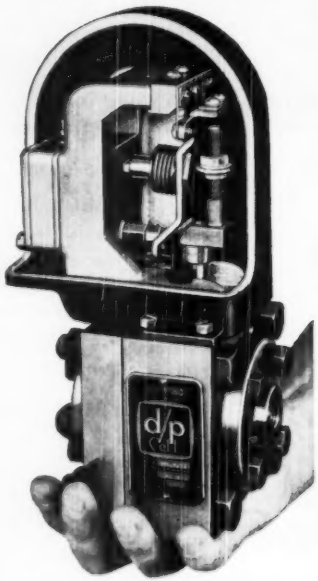
FOXBORO

DIFFERENTIAL PRESSURE CELL

Now you can simplify many troublesome flow problems . . . especially those where corrosion is a factor or the use of mercury is objectionable. This unique flow measuring device is accurate, easily calibrated, and widely applicable, and it weighs only 20 lbs.

The Foxboro d/p Cell operates on the highly-accurate force-balance principle, transmitting flow measurement to remote, conveniently-located pneumatic receiving instruments (indicating, recording, controlling). Range: 80 in. to 800 in. H_2O. Working pressures: 750 psi and 1500 psi.

Get all the facts about this revolutionary new device for the measurement of liquid, steam, gas or air flow. Write for Bulletin 420. **The Foxboro Company, 68 Neponset Ave., Foxboro, Mass., U.S.A.**



UNIQUE ADVANTAGES

1. *Type 316 Stainless Steel Construction.*
2. *Uses no mercury.*
3. *Essentially zero displacement — no need for condensing chambers on steam measurement or seal pots on liquid measurement.*
4. *Immediate, unfailing response to differential pressure changes.*
5. *Positive overrange protection.*
6. *Easy zero and range adjustment.*

FOXBORO REG. U.S. PAT. OFF.

RECORDING • CONTROLLING INDICATING INSTRUMENTS

THE BOOKSHELF

(*Continued from page* 154)

material for one class discussion under a qualified instructor.

Using a limited amount of arithmetic, the author attempts a practical down-to-earth explanation of generation, transmission, distribution and metering of electrical energy. He covers operation of the main equipment in the industry and meaning of electrical terms the employe hears.

ELECTRONICS, PRINCIPLES AND APPLICATIONS (1950). *By Ralph R Wright, associate professor of electrical engineering, Virginia Polytechnic Institute.* 387 *pp.* 6x9, *illust, cloth.* $5.50. *Ronald Press Co,* 15 *E 26th St, New York, N. Y.*

This college text for nonelectrical engineering students, is also suitable for electrical-engineering students and, as a refresher course, for practicing engineers.

Material is in three parts: Chapters 1-3 present basic electronic principles; chapter 4 reviews dc and ac circuits; remaining 8 chapters deal with basic applications of electron tubes. Included in the applications are amplifiers, oscillators, rectifiers, cathode-ray tubes, light-sensitive devices, X-ray tubes, high-frequency heating and basic-control circuits.

Text gives good grounding in basic principles of electronics and how they can be applied to control industrial processes. Treatment is, therefore, not highly mathematical, but is qualitative rather than quantitative.

WARM-AIR HEATING AND WINTER AIR CONDITIONING (*2nd edition,* 1950). *By John W Norris, Lennox Furnace Co.* 320 *pp,* 8½x 11½, *illust and indexed, cloth,* $6.50. *McGraw-Hill Book Co,* 330 *W 42nd St, New York* 18, *N. Y.*

Here are fundamentals of design, installation, adjustment of warm-air and winter air-conditioning systems. Fundamentals are presented as they appear to a practical man from a lifetime in the business. The result is highly practical not only for the student but also for the man who makes his livelihood in the field.

The author establishes a common ground for all by starting with a short chapter defining the terms used throughout. Next he brings up types of heating systems commonly found, how they differ, advantages.

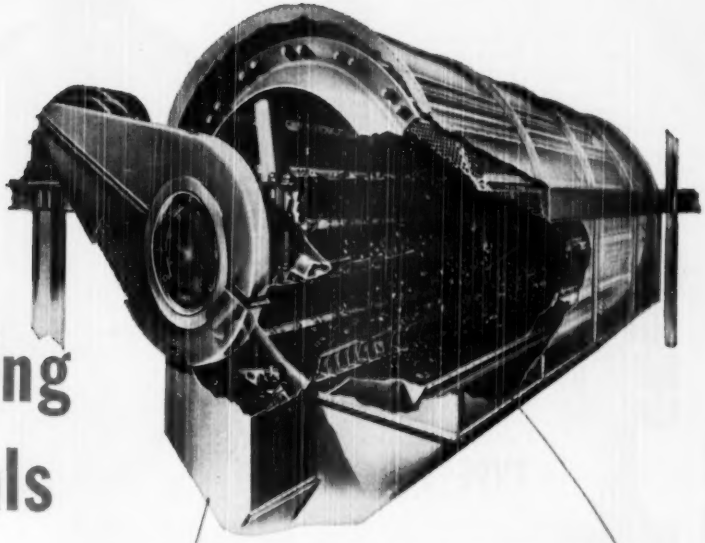
One highly important chapter acquaints the reader with some basic construction fundamentals. It develops the need for heating contractor and builder to get together in the planning stage to lay out the heating plant. It saves construction costs and produces a better heating system.

MANUAL OF ELECTRIC INSTRUMENTS (*Manual GET 1087A*). *General Electric Co,* 140 *pp,* 9x11, *cloth,* $1. *Advertising and sales promotion divisions, General Electric Co, Schenectady, N. Y.*

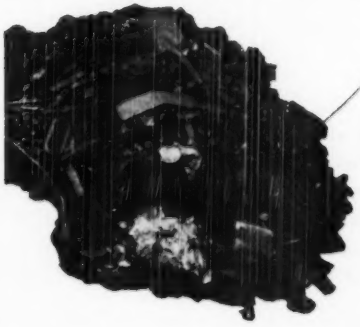
This manual, based on teaching material successfully used in GE training courses, is meant for technical schools and colleges. It may well be used as a refresher course for engineers who want to improve their acquaintance with the measuring tools of the electrical industry.

Operating principles of commonly used

Uniform, Free-Flowing Steam Coals



minus debris

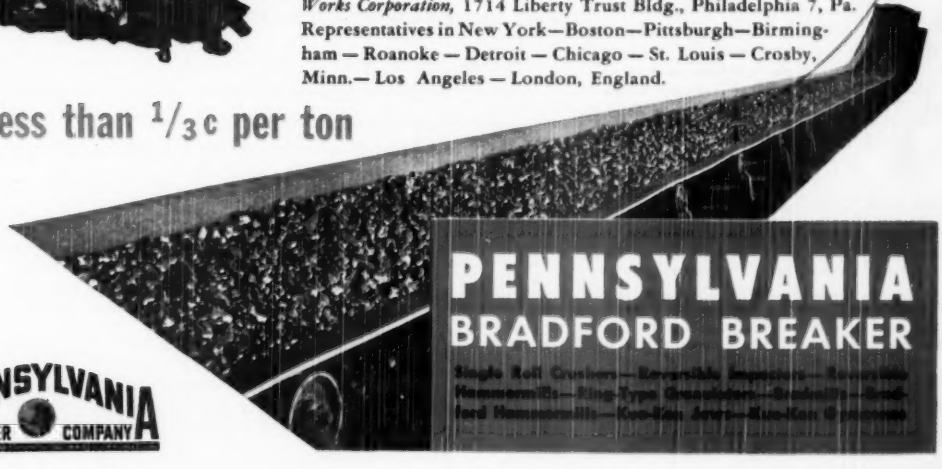


Pennsylvania Bradford Breakers crush and clean ROM coals in *one* operation. Mechanically simple, the Pennsylvania Bradford is a big, revolving, screening cylinder fitted internally with deflecting lifting shelves. Coal, delivered to the feed end, is continuously lifted and dropped as the cylinder turns at an economical 12-18 RPM. Passing sizes escape through the screen holes immediately (no overcrushing), while larger lumps stay trapped until shattered by the constant drop impact. All debris larger than the screen perforations travels to the end of the breaker and is automatically scooped out by a plow. The result: a uniform product containing minimum fines, no oversize, no large debris—an ideal feed for efficient pulverizer and stoker operation. Debris elimination minimizes damage and shutdown of pulverizers.

Power demand of these Steelbuilt Pennsylvania Bradfords—less than ¼ HP per ton. Maintenance costs—less than $.001 per ton for parts *and* labor. For Central Stations and Industrial Plants; capacities up to 1000 TPH. Write for Bulletin 3007.

PENNSYLVANIA CRUSHER COMPANY, *Division of Bath Iron Works Corporation,* 1714 Liberty Trust Bldg., Philadelphia 7, Pa. Representatives in New York—Boston—Pittsburgh—Birmingham — Roanoke — Detroit — Chicago — St. Louis — Crosby, Minn.— Los Angeles — London, England.

for less than 1/3 c per ton



PENNSYLVANIA BRADFORD BREAKER

Single Roll Crushers—Reversible Impactors—Reversible Hammermills—Ring-Type Granulators—Sized-Feed Hammermills—Kue-Ken Jaws—Kue-Ken Gyrasons

PENNSYLVANIA CRUSHER COMPANY

Now..
with the
FEED

TYPE 149

Ample Power for Direct Action ...Easily Adapted to Remote Control

For Quick Solutions of Tough Problems, Count on *Climax!*

You'll be amazed at the ease with which a BS&B Controls Engineer can end your control worries. Strategically located, he is always ready to give you complete, understanding service... in strict confidence. Check the coupon below for the BS&B Controls Man nearest you.

You have a leverage ratio of 18 to 1 forming the connection between float and inner valve plug in the valve body of the BS&B-Climax 149 Feed Water Regulator. This means ample power to operate against differentials across the valve as usually encountered. Designed to serve as Feed Water Regulator or as Liquid Level Control. Combines the economy with the proved efficiency of Climax top-and-bottom-guided, reversible valve bodies.

Employ the type 149 float cage for direct control of level, remote of valves or instruments through air pilots, and operation of alarm systems or signals through Mercoid switches. Yes, sir... you can't beat this BS&B-Climax Control for versatility!

BLACK, SIVALLS & BRYSON, INC.
Climax Controls Division, Section C1-6-8
720 Delaware Kansas City, Mo.

Send complete information on following items, as checked: ☐ Type 149 Feed Water Regulator ☐ Type 320 Pressure Reducing Regulator ☐ Type 86 Diaphragm Valves ☐ Type 850 Displacement Liquid Level Controllers ☐ Have Sales Engineer call. Also send name of nearest BS&B Controls Man.

NAME_____

TITLE_____

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STREET_____

CITY_____ STATE_____

Models available... in high tensile cast iron for pressures up to 250 psi, cast steel for up to 500 psi.

Complete description, diagrams, specifications and applications are ready for you. Mail the coupon... today!

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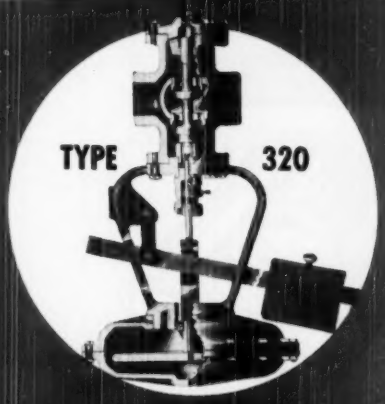
KANSAS CITY • OKLAHOMA CITY • TULSA

Efficiency at a Real Saving

New BS&B Climax WATER REGULATOR

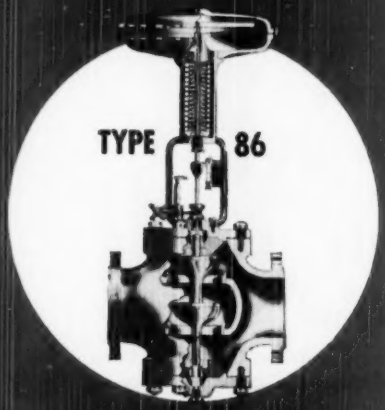
PRESSURE REDUCTION OR BACK PRESSURE REGULATOR

Type 320 Regulators allow sensitive pressure control in vapor-vacuum and low-pressure steam heating systems. Weight loaded, pressure operated, diaphragm actuated. Built for long life under rugged conditions.



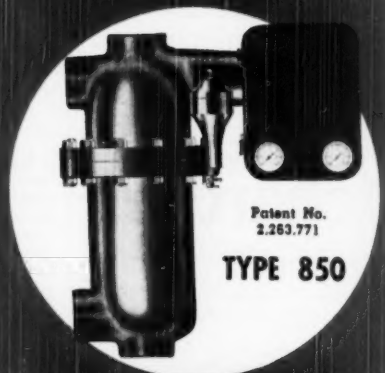
DIAPHRAGM CONTROL VALVE

Type 86...famous the world over for high lift, accurate control, ease of maintenance. Fully reversible in the field. Super-polished lower stem for minimum friction. Wide rangeability. Check coupon for catalog.



DISPLACEMENT LIQUID LEVEL CONTROLLERS

No leakage...no stuffing box...no friction problem! That's the Type 850, a BS&B-Climax-developed exclusive. Ideal wherever liquid level control involves exacting and wide range control. Shown here with Type 1410 BS&B-Climax Control Pilot. Complete catalog available...send coupon now.



instruments are stressed. Consideration is also given to many special instruments that have evolved from fundamental forms. Electronic instruments are for the most part omitted since they represent circuit developments rather than basic instrumentation.

ELECTRICAL METERMAN'S HANDBOOK (*6th edition*). *Edison Electric Institute Handbook Committee*, 615 *pp*, 6x9, *cloth*, $4.90. *Edison Electric Institute*, 420 *Lexington Ave, New York* 17, N. Y.

Basic principles of electric metering of energy and power with descriptions of modern meters. Complete tables of constants for ac and dc meters covering all types, old and new, in current use. More than 500 photographs and line drawings supplement text and tables.

In addition to specific information on individual meters the book outlines methods of measurement, principles of demand meters, problems in special metering and in routine meter testing. Many practical hints are included about the meter shop and laboratory.

SCIENTIFIC AND TECHNICAL ABBREVIATIONS, SIGNS AND SYMBOLS (*second edition*—1949) *By O T Zimmerman, professor of chemical engineering, University of New Hampshire, and I Lavine, formerly professor of chemical engineering, University of North Dakota.* 541 *pp*, 6x8½, *illust, tables, cloth. Industrial Research Service, Masonic Bldg, Dover, N. H.*

This edition appearing just one year after the initial issue is prompted by material becoming available in that interval. Major items are American Standards for physics, electrical quantities and aeronautics and aerodynamics; revisions of American Standards; adoption of the international weather code, new military abbreviations.

As the earlier edition, this one covers a wide range of technical fields. The authors hope to encourage greater uniformity in the use of these factors.

ELECTRICAL FUNDAMENTALS, CIRCUITS AND MACHINES FOR ENGINEERS (1950). *By R W Ahlquist, associate professor of electrical engineering, Iowa State College.* 400 *pp*, 6x9, *illust, cloth.* $5. *Pitman Publishing Corp*, 2 *W 45th St, New York, N. Y.*

The scope of electrical engineering has been widened considerably. Developments in electronics and high frequencies, new materials and broader use of mathematics have had their effects. So in this book, an outgrowth of notes used in teaching electrical engineering, the student gets a broad, general knowledge.

The first chapter introduces him to electronics. Although two later chapters deal with this subject exclusively, it also permeates much of the text. Essential fundamentals of potential differences, circuits, magnetic and electrical fields, machines and concepts of power and energy are presented according to their importance.

Dc motors and generators are presented so the student recognizes them as modifications of the same machine. Synchronous machines are similarly treated, and the transformer and induction motor are shown to be intimately related. Illumination, instruments, motor control and electrical distribution each receives one chapter.

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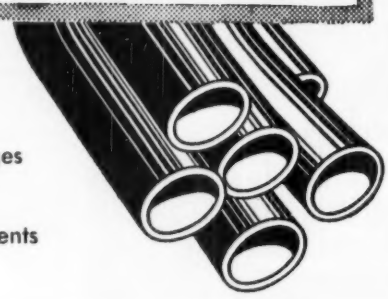

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PLANT PROBLEMS

(*Continued from page* 136)

input and steam output.

If *CH* has tested feedwater meter and found it greatly in error, for example, there is no use trying to obtain any result using data taken from this meter. Following points should be established first:

1. There is no leakage of feedwater between meter and boilers, as into steam side of a feed heater.
2. All water from boiler blowdown and steam traps, including flash steam, must be accounted for.
3. There is no steam leakage from boilers, as at tube ends, valve stems, traps, etc.
4. There is no unmetered steam used from boilers, as for oil atomizing, pump drive, etc.
5. Steam flowmeter orifices are properly installed at right distances from pipe bends and other fittings.
6. Tubing is open between orifice plate and meters.
7. Meters contain proper charge of mercury. Incompetent workmen often blow mercury out of meter when cleaning lines.
8. Edge of meter is sharp.
9. Boiler pressure is constant.
10. Proper multiplication factor is being used.

With these conditions, apparent increase in steam output over feedwater input when load increases could be caused by uncompensated-for drop in line pressure between boilers and orifices. Such a drop across too-small a nonreturn valve would not show on boiler gages or manometer tests across the orifice. This pressure difference increases with load causing meters to register greater amount of steam than is actually flowing, if not compensated for by multiplication factor.

CH should test steam line pressures by gage at meter orifices. If they vary appreciably from boiler pressure, or boiler pressure falls under load, meters show false reading. Corrected multiplication factor must be used to get true steam output at lower pressure.

GEORGE HOLMAN *Decatur, Ill.*

Editor's note: We received many other good answers but don't have space for all this month. We'll try to publish the remaining answers next month.

Proceedings of **Mine Safety Conference,** held in Pittsburgh in 1948, are now available in printed form. The proceedings, known as Bulletin 489, *Proceedings: Fifth International Conference of Directors of Mine Safety Research,* may be obtained from the Supt of Documents, U. S. Government Printing Office, Washington 25, D. C. for $1.25.

Why should Exide quarrel with Mr. Diesel?

Exide shouldn't . . . didn't . . . even though **Mr.** Diesel's engine presented a cranking problem that was plenty tough.

The whole success of Mr. Diesel's invention depends on its terrific compression.

So the very thing that makes Mr. Diesel's engine possible, puts an unusually heavy load on a starting battery.

Exide couldn't change this, but it could design a starting battery to meet the requirements. So that's what Exide did.

Even if Mr. Diesel had purposely tried to "stump" batteries, you are never going to know it, judging from the quick breakaway and high cranking speed furnished by Exides.

Let Mr. Diesel, the weatherman or the engine's temperament try stumping an Exide Diesel Battery. It can't be done. Exide has built this battery to make Diesel starting easy. This battery does it.

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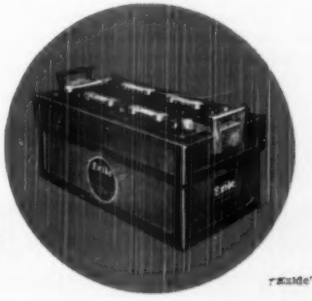
is responsible for developing, improving and testing Exide Batteries. Exides for Diesel cranking are forced to live through factory tests that are much tougher than actual service.



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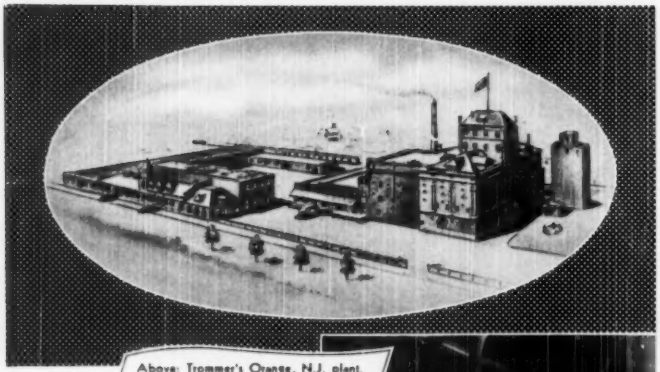
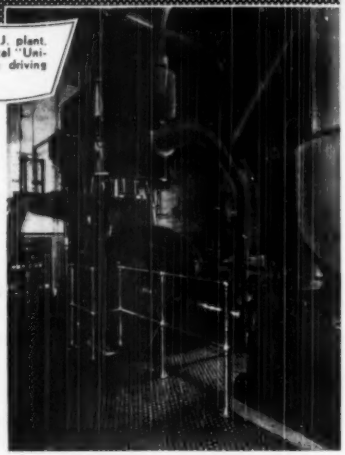


Above: Trommer's Orange, N.J. plant. Right: Skinner 2-cylinder Vertical "Universal Unaflow" Steam Engine driving ammonia compressor.



7

SKINNER

"Universal Unaflow"

STEAM ENGINES

for TROMMER BREWERIES

as increasing sales require expanded facilities

John F. Trommer, Inc., Brooklyn, N. Y., purchased its first Skinner "Universal Unaflow" Steam Engine, driving an electric generator, in 1928. As the result, in 1933 when Trommer acquired an old brewery in Orange, New Jersey, and completely remodeled it, the selection of the power source was a natural conclusion—two Skinner "Universal Unaflow" Engines being installed.

Since that time, as increased sales required expanded facilities, one additional "Universal Unaflow" Engine was installed in the Brooklyn plant and three "Universal Unaflow" Engines in the Orange plant. Of the seven engines now installed, three are directly connected to compressors and four to electric generators.

Breweries, dairies, and other processing industries have found a double economy in producing their own power with Skinner "Universal Unaflow" Steam Engines, because in addition to a dependable source of low-cost power they have been able to employ the exhaust steam for hot water generation, pasteurization, space heating and other uses.

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For Over 80 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

AIR CONDITIONING

(*Continued from page* 93)

a process-steam source for a future restaurant. Drips from medium- and high-pressure headers collect in a flash tank. Condensate from these services is pumped to the sewer through economizers, preheating the water supplied to wash rooms and janitor's closets. This reduces condensate temperature to 100 deg. the maximum at which water is permitted to enter the city draining system.

Snow Melting. 8500 square feet of sidewalk constitute a snow-removal problem of sufficient magnitude to warrant considering a snow-melting system. The very term "snow removal" implies an accumulation of snow that continues to exist for the duration of the snow fall. Thus, even with efficient removal, there is the possibility of accidents and resulting damage suits.

System designed for this building consists of a pump, circulating an ethylene-glycol solution (in water) through a network of grid coils. Grids are $\frac{3}{4}$-in. Schedule 60 black pipe, and headers of $1\frac{1}{4}$-in. Schedule 60 black pipe, with welded joints throughout. Solution is heated by a steam-operated exchanger, and a return liquid temperature of 140 deg is maintained. A safety control prevents liquid temperatures in excess of 163 deg, to assure stability of solution. The controls become operative when the circulating pump starts.

Automatic Temperature Control. A pneumatic system of temperature control derives its constant-pressure air supply from two reciprocating compressors in the cellar.

Two central manual switches, one in refrigeration machine room and one in the 20th-floor machine room, govern summer and winter operating cycles.

Because of high pressures developed by primary-air fans, their associated outdoor-air dampers are controlled so they open fully before the fans can start.

Humidity control as such was not provided. Air-conditioning systems in this building supply mixtures containing between 50 and 100% outdoor air. With the chilled-water temperature fixed at 41 deg, and with outdoor conditions of 95 deg dry bulb and 75 deg wet bulb, resulting indoor conditions are 80 deg dry bulb and 50% relative humidity. Reduction in outdoor temperature would represent load reduction and cause a temperature drop of water returning to the cooler. Reduced average cooling-coil temperature depresses the apparatus dewpoint and thus the space dewpoint. This permits lowering the interior-system floor thermostat-control-point settings in cooler weather without increase in space relative humidity. Because of this inherent performance char-

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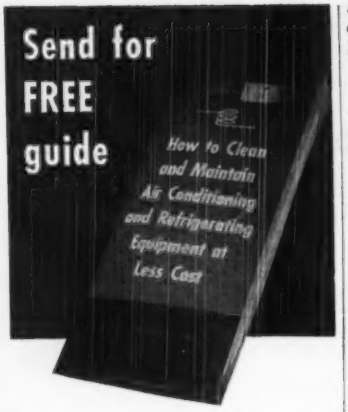

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acteristic, no automatic control of chilled-water flow or temperature was incorporated.

A requirement basic to the economic planning of projects of this nature is the close collaboration of owner, architects, engineers and contractors. This was realized in large measure during the planning, design and construction phases of this building. The following firms were connected with the work described:

Architects: Ely Jacques Kahn and Robert Allan Jacobs. *Structural engineers:* Fred N Severud. *Mechanical and electrical engineers:* Jaros, Baum & Bolles; Smith & Silverman (associates). *General contractors:* George A Fuller Co. *Air conditioning, ventilating and heating subcontractors:* Kerby Saunders, Inc, and Carrier Corp. *Air-conditioning equipment:* Carrier Corp.

ELECTRONICS

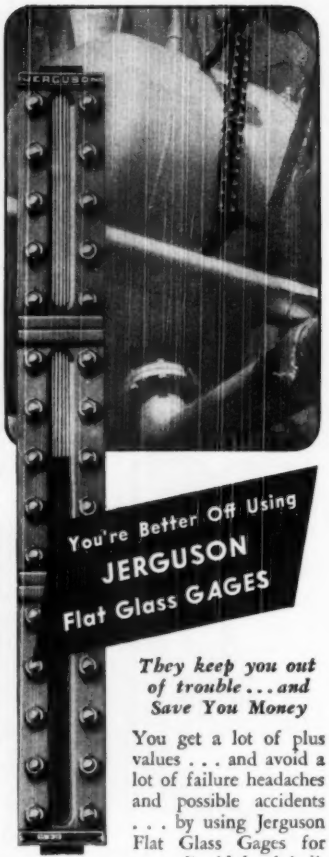
(*Continued from page* 128)

to block the circuit from D to anode A. Capacitor C is also charged, and when the polarity of the transformer reverses, the capacitor discharges through resistor R_2. It also tries to discharge from grid to cathode D to maintain a minus bias on this grid to block the circuit through R_1 and S_2.

Absence of current through R_1 removes the minus bias from the grid of tube T_1, and the relay coil is energized through it. A circuit for this coil is from secondary S_2, cathodes D_2, anodes A_2, secondary S_1 and the relay coil. Energizing this coil opens contacts L_1 and L_2, and closes contact L_3. Opening contacts L_1 and L_3 opens the pilot-lamp and ignition-coil circuits, but the pilot valve is held open by a circuit through the pushbutton. The pilot light going dark shows the operator that the pilot flame has been established and has contacted the electrode.

Main Gas Valve. Closing of contacts L_3 completes the main gas-valve coil circuit from − line through the main gas-valve coil, contacts L_3, the stop button and to the + line. This valve opens but the operator holds the start button until the main burner ignites, when he releases this button. The main valve circuit remains closed through the stop button. As long as the flame contacts the electrode, the relay holds its contacts closed to the flame position.

Should the flame fail for any reason, it will remove minus bias from grid G. This tube will again complete the circuit for secondary S_2 through resistor R_1 to put a minus bias on the grids of tube T_1, and block the relay-coil circuit. Its contacts then return to the start position and break the main gas-valve circuit through contacts L_3, after which the valve closes. The system remains in



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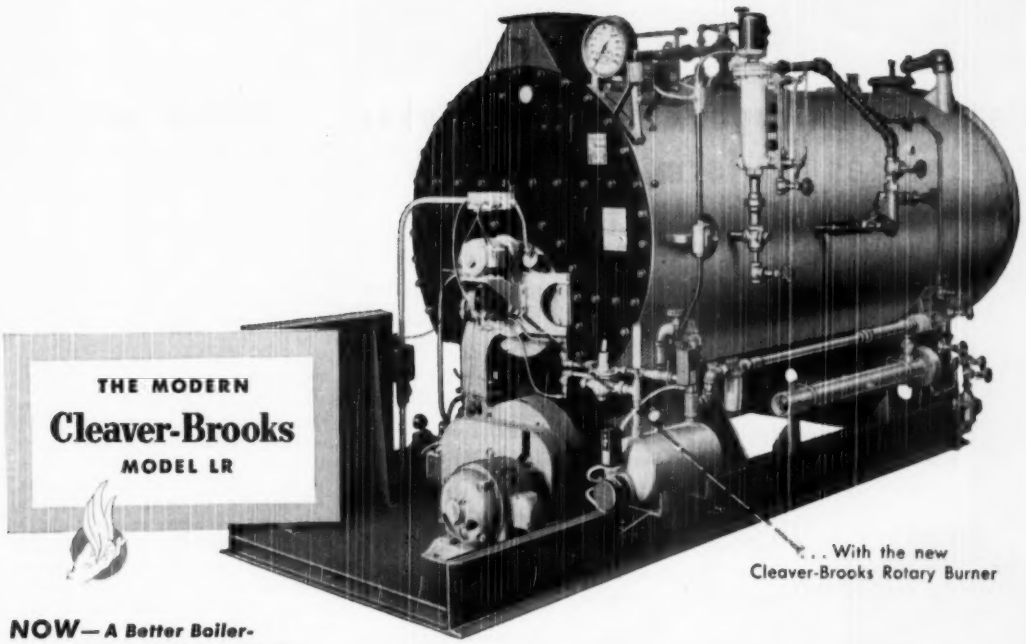

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— the new Cleaver-Brooks rotary burner — simple — compact — precision machined — perfect mechanical balance — fully automatic — provides unprecedented flexibility in burning heavy fuel oils or industrial gases.

— single low-speed, low-power consumption blower furnishes both primary and secondary air for combustion—less weight and space requirements — reduction in sound levels.

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— electronic combustion safety devices, dual low water cutoffs — are standard equipment.

— simplified design of combination gas-oil burner permits change-over from oil to gas or vice versa in less than a minute.

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— boilers of all-welded construction — meet standards of A.S.M.E. boiler code and leading underwriters — burner approved by recognized national agencies.

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a safe no-flame position until the start button is pressed when the starting operations just described repeat.

During normal operation, pressing the stop button opens the main gas-valve coil circuit and this valve closes. Operator holds the button open until he sees the pilot lamp light. Then he knows the equipment has returned to safe no-flame position.

Ground on Electrode. If the electrode were to bend down and touch the gas burner it would form a closed circuit to ground the same as when a flame exists. This danger is provided against because when the electrode grounds, capacitor C discharges so rapidly through R_1 that minus bias on grid G is reduced to where its side of the tube conducts. It puts a minus bias on tube T_1 grids and blocks this tube. The tube then acts the same as when the flame extinguishes, the relay opens its contact to close the fuel valve and light the pilot light.

Next article will describe two more systems of flame-failure protection.

TECHNICAL BRIEFS

(*Continued from page* 138)

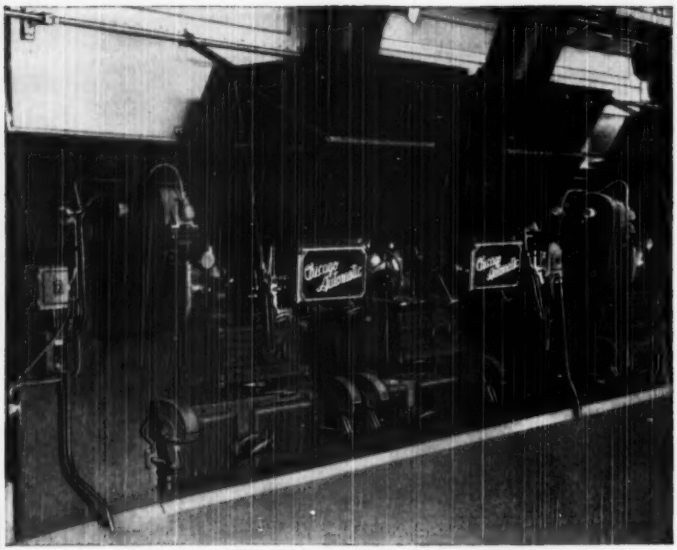
one class from its stated ratings.

An interesting feature of this paper is the relatively complete analysis of transformer selection for a 400-megawatt central station. The proposed design is outlined and a step-by-step analysis made to show where maximum savings can be effected. *AIEE paper No.* 50-167.

SELECTION AND APPLICATION OF POWER TRANSFORMERS, *by Howard C. Seelye, Detroit Edison Co, Detroit, Mich.* This, the second of three papers dealing with economy considerations in selecting and applying power transformers, branches off on a discussion of standardization. A suggested approach is outlined for those who are setting up standards. A keynote on this phase of the paper was to the effect that the cost of unavoidable "specials" should not be greater because of the existence of standards than they would be if there were no such standardization.

The author then takes up several of the more important features of power transformers, with particular attention to the relation between the needs of the operating system and some of the standardization activity now in progress. Some of the industry's needs are outlined. For instance, a total range of taps of about 15% on the high-voltage side of the transformer is generally needed in the industry.

Further discussion branches out into 34.5-kv transformers linking in the work of the standardization groups. The author then continues on his standardization-operator survey, including a discus-



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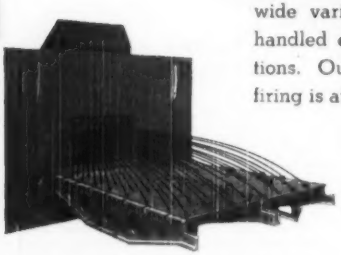

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Look at the following figures, and you won't wonder that the plant's estimated annual savings on treating chemicals exceeded $6,000!

CHARACTERISTICS	Conventional Design	Sludge Blanket Design
Silica in raw water, as SiO_2 ppm	55	55
Silica in effluent, as SiO_2 ppm	11	2.0
MgO feed, ppm	76	59
Parts SiO_2 removed per part MgO	0.6	1.1
Average retention time of $Mg(OH)_2$ in hours	4.7	100
Contact time of water with $Mg(OH)_2$ in minutes	92	87
Hardness of effluent, as $CaCO_3$ ppm	21	15
Average load on softener, % rated capacity	65	46
Temperature in softener	220°F	243°F

The Permutit Hot Process offers your plant other benefits as well: More efficient use of magnesia! Longer filter runs! Lower turbidity in settling tank effluents! Greater adaptability to flow rate fluctuations! Here indeed is another achievement that spells "Permutit Leadership in Water Conditioning!"

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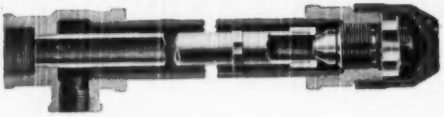

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Other features: easily installed; discharge air as efficiently as water; no air binding; hardened stainless steel valve, seat. Lengths, 18" to 40". Press., 0 to 250 lbs. without change of valve or seat.

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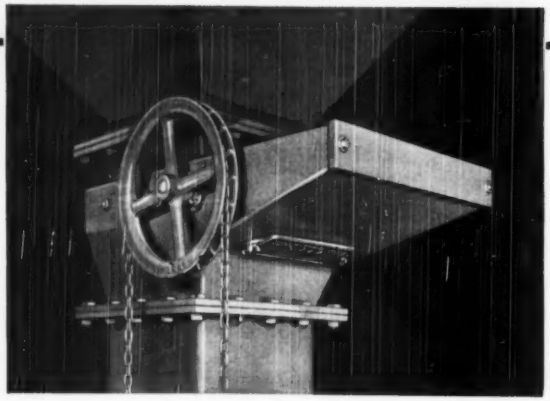

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sion on kva ratings, oil preservation, noise, and transformer loading. *AIEE paper No.* 50-134.

CHOICE OF MAIN POWER TRANSFORMERS *for Generating Stations, by N E Dillow, General Electric Co, Schenectady, N. Y., and J W Butler, General Electric Co, Pittsfield, Mass.* This third link of the group of papers concerned with power transformers for generating stations concerns itself with the practice that affects selection of main power transformers as far as cooling methods, kva size, voltage, insulation, etc, are concerned.

After a review of the cooling method in power transformers, the author establishes an economical approach in the choice of transformer cooling by setting up an example. Specific case deals with a 16,000-kw turbine-generator. Additional practical limitations are included before the actual analysis is made.

The author establishes his reasoning for choosing the transformer at kva rating, cooling, voltage, transformer impedance.

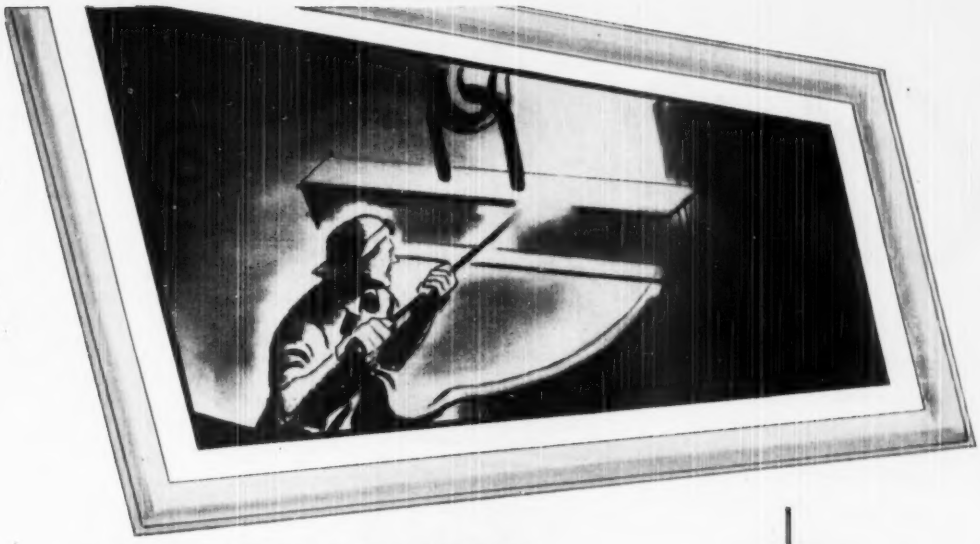
Further saving can be had by eliminating the conventional request for four taps on 2-winding transformers and six taps on 3-winding transformers. Since these are the maximum permissible number of taps manufacturers provide without a price increase, it is customary to include them in the specifications. But if all taps are omitted there is saving of 4% in the base price of the transformer. With modern analytical methods, such as the ac network analyzer, system performance can be accurately determined in the planning stage. As a result, one does not need to specify extra taps to take care of operating contingencies as in past practice.

As in the previous paper, the question of insulation philosophy is also discussed here. This is a matter of reducing the insulation voltage level in transformers.

The author makes a few comments to the effect that generally the transformer should be about the 15-lb hydrogen-cooled kva rating of the generator; transformer primary voltage should be about 5% below generator-voltage rating; reduced insulation philosophy is based on sound engineering principles. *AIEE paper No.* 50-128.

Power Generation

HYDROELECTRIC GENERATOR EXCITATION EXPERIENCE AT GRAND COULEE, *by C L Killgore and N G Holmdahl, U. S. Bureau of Reclamation.* Grand Coulee power plant on the Columbia River, in Washington, has the largest concentration of generating capacity in the world,



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having installed 1,316,000 kw, with ultimate capacity to be 1,974,000 kw. Bureau of Reclamation is building and operating this plant as a major feature of the Columbia Basin project.

This plant differs from most modern hydroelectric plants in that only twelve of its eighteen 108,000-kw main units have direct-connected exciters. The other six, which are to drive twelve 65,000-hp synchronous pump motors, as well as furnish commercial power, have separate motor-driven exciters. Since these six main units have exciters whose motors are driven by two 10,000-kw station-service generators, the problem of loss of generator excitation is important. This paper covers experiences obtained from the original power layout for these exciter motors and development of the final plan for ensuring power supply to these motors. It also covers experiences with loss-of-field relays and excitation under heavy-load rejections.

In a summary the authors say: 1. Experience with the motor-driven exciters at the Grand Coulee power plant indicates that automatic transfer of power sources to the motors can be successful under full load by removing the motor from a faulty power source and reconnecting it to another.

2. But experience also indicates that the best protection is to provide sufficient power sources so loss of one will not cause loss of excitation.

3. Additional pilot-exciter voltage-regulation equipment has reduced peak voltages on the generators about 1.5 kv on a 13.8-kv base, with the possibility of reducing this still further by adding more resistance in the high-speed lowering relay circuit in the main exciter field. *AIEE paper No.* 50-137.

DETERMINATION AND ALLOCATION OF CAPACITY BENEFITS RESULTING FROM INTERCONNECTING TWO OR MORE GENERATING SYSTEMS, *by C W Watchorn, Pennsylvania Water & Power Co.* Interconnection of two or more electric-generating systems always reduces amount of generating capacity to install as compared with that needed before interconnection. The reduction may be large or small, depending on the interrelation of various factors and characteristics of the interconnecting system and desired level of service reliability. Installation of transmission facilities necessary to bring about the interconnection may or may not be justified. This can be determined only by a proper comparison of the economy of alternate installations.

Having decided to interconnect two or more generating systems, some plan or basis is necessary for allocation of the resulting capacity benefits among the interconnecting systems.

(*Continued on page* 200)

PLANT EQUIPMENT NEWS

Reader Service Page for New Products and Literature

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATION

A4 DEHUMIDIFICATION — 4-page bulletin supplies facts about dehumidification for industry concerning problems such as mold, fuse mildew, caking, corrosion, warping, dripping floors, wet walls, etc. Industrial Supply Co., W. 2d 51st Drive, Woodside, N. Y.

A5 FANS AND BLOWERS — 32-page catalog No. TMC-171-1950 gives engineering data on series 16 standard and high capacity ventilating units. The Moore Company, Barcelona, Missouri.

BOILERS AND AUXILIARIES

B4 GAS BURNERS — 4-page bulletin No. B-61 gives the highlights of the Series PW MidKee pilot Wallitite burners. Eclipse Fuel Engineering Company, Rockford, Illinois.

ELECTRICAL EQUIPMENT

F5 POLYPHASE MOTORS — 12-page bulletin No. EH5-113 polyphase 1 to 15 hp industrial electric motors, illustrating construction details in cross sections and exploded views. Among the features described are motor appearance, insulation, bearings, ventilation, mounting, service, frames and end bells. A O Smith Corp, Motor Div, Los Angeles 31, Calif.

F6 ELECTRICAL ENCLOSURES — 16-page booklet No. E8 contains over 40 illustrations plus descriptions of custom built sheet metal electrical enclosures. The Kirk & Blum Mfg Co, 3115 Spring Grove Avenue, Cincinnati, Ohio.

F7 INDUSTRIAL LIGHTING — 44-page booklet, revised edition of RLM Standard Specifications for Industrial Lighting Units, contains four new specifications which utilize T-12 slimline fluorescent lamps, and revisions of existing RLM specifications including increase in mean reflection factor on 12 different units from 75% to 82 1/2%. RLM Standards Institute, 326 W Madison St, Chicago 6, Ill.

F8 MAGNET WIRE — 32-page booklet No. 19-510 gives complete information on Formex and Isoformex magnet wires. Considered fitting of both film-type and asbestos and glass-insulated magnet wires, and fully covers the development, properties, applications, advantages, and available sizes of these wires. General Electric Co, Bridgeport 2, Conn.

F9 SAMPLE APPLICATIONS — 8-page pictorial presentation of what industry is currently doing to modernize machine designs and production lines to meet today's highly competitive conditions through greater plant production and improved quality. Sterling Electric Motors, Inc, 5161 Alhambra, Telegraph Road, Los Angeles 22, Calif.

F10 TRANSFORMERS — 16-page bulletin No. 01B4136H gives design and construction features of Allis-Chalmers power and distribution transformers, both large and small and secondary network. Also discusses step regulators, pole-type regulators, unit substation and instrument transformers. Allis-Chalmers Mfg Co, 931 S 70th St, Milwaukee, Wis.

F11 DIRECT CURRENT MOTORS — 4-page bulletin No. [illegible] describes direct-current motors, their

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motor designs and parts. The Electric Products Co, 1785 Clarkstone Road, Cleveland 12, Ohio.

F12 LIGHT DIMMERS—16-page bulletin No. 76 discusses resistat and autoresist dimmer tandem lighting control. Gives features, construction, operation, and dimensions. Ward Leonard Electric Co, 31 South Street, Mount Vernon, N. Y.

F13 MOTORS AND GENERATORS — 16-page booklet describes induction motors and generators for instrumentation and control work, includes 8 new types. Typical specifications, performance curves, and outline drawings given. Arma Corp, 254 36th St, Brooklyn 32, N. Y.

F14 GEARMOTORS — 4-page bulletin No. B250 describes 3-hart right angle type gearmotors from 1/6 to 5 hp with ratios of 5-4/5-1 to 100-1. Output speeds are from 17.5 rpm to 343 rpm. Abart Gear and Machine Co, 4628-4634 W 16th St, Chicago 50, Ill.

MAINTENANCE AND SAFETY EQUIPMENT

K1 INDUSTRIAL APRONS — 4-page catalog No. 1301.0 describes Korseal lightweight, resistant roofing aprons. Describes, also, aprons made of different types of rubber for particular usages, including light and heavy duty. B. F. Goodrich Co, Akron, Ohio.

K2 INDUSTRIAL TOOLS — 20-page bulletin No. P1500 illustrates and describes new tools designed to accomplish difficult removing and replacing operations without costly irreplaceable parts. Owatonna Tool Co., 278 South Cedar St, Owatonna, Minn.

K3 FIREPROOF DOOR — 4-page brochure describes a new wood-faced fireproof door with a fire rating for Class B and C openings from Underwriters' Laboratories. Door has inorganic core which does not burn, is rot and vermin-proof. Kaylo Div, Owens-Illinois Glass Co, Toledo 1, Ohio.

K4 SEALING RING — 2-page folder No. 117-C describes Flexo-Seals, new standard equipment for Frick enclosed-type ammonia, Freon-12 and booster compressors. Frick Co, Waynesboro, Pa.

MAINTENANCE MATERIALS

L8 CORROSION PREVENTION — 4-page bulletin No. 51 announces the new Metco Systems for corrosion prevention. This metallizing prevents rust on tanks, bridges, piling, ship and boat hulls, refrigeration equipment and fabricated steel products for long periods of time. Metallizing Engineering Co, Inc, 38-16 30th St, Long Island City 1, N. Y.

L9 PAINT REMOVER — 12-page booklet No. P-7193 gives an account of materials and procedures designed to simplify the removal of oil base and synthetic paints, enamels and similar finishes from metal surfaces. Oakite Products, Inc, 133 Thames St, New York 6, N. Y.

L10 RUBBER MATTING—Three sales log sections. Bulletin No. 6108 describes rubber matting; bulletin No. 6109 describes perforated matting; bulletin No. 6110 describes anti-fatigue and utility mats. Data and specifications on each of the types included. The B. F. Goodrich Co, Public Relations Dept, Akron, Ohio.

L11 SOCKET SCREWS — 8-page bulletin No. 581 illustrates and gives full information on specifications and prices of small wire-size multiple-spline socket cap screws and set screws. The Bristol Co, Waterbury 20, Conn.

MATERIALS HANDLING

M5 SWIVEL SPOUT—Data Sheet No. 1501 contains complete specifications for a new dust-tight swivel spout designed to eliminate routing of leashes by dusty swivels or conveyor gloves. Three-plan diagram is included, all dimensions marked. Richardson Scale Co, Clifton, N. J.

M6 ELECTRIC HOISTS—7-page bulletin No. H-111 describes the Whiting electric hoists in 1, 2, and 3 ton capacities. Specifications and accessories included. Whiting Corporation, Harvey, Illinois.

M7 LIFT TRUCKS — 4-page folder gives information each on low-motor gas-powered fork lift trucks. Elwell-Parker Corporation, 1156 East 61st St, Cleveland 14, Ohio.

M8 MAGNETIC SEPARATOR — 8-page catalog No. C-1168-A illustrates and describes the application, operation and design of the Dings non-electric, Alnico Perma-Drum magnetic separator. Available in three models. Design features, data on capacities and dimensions included. Dings Magnetic Separator Co, 4740 W Electric Ave, Milwaukee 14, Wis.

MECHANICAL TRANSMISSION

M3 VARIABLE SPEED—4-page bulletin No. 5249 discusses the P.I.V. variable speed drive with four basic control systems: electronic, pneumatic, hydraulic and mechanical. Link-Belt Co, 300 W Pershing Rd, Chicago 9, Ill.

METALS AND ALLOYS

R1 METAL PARTS — 60-page hard-facing manual describes how to select the right alloy; which welding process to use; and simple instructions for applying the various rods by both the oxy-acetylene and metallic-arc welding processes. Also gives properties and sizes of 13 Haynes hard-facing materials. Haynes Stellite Div, Union Carbide and Carbon Corp, 725 South Lindsay St, Kokomo, Ind.

R2 NICKEL ALLOYS—Two bulletins offered. 15-page each. Bulletin No. T-5 gives the engineering properties of K Monel and KR Monel. Bulletin No. T-7 gives the engineering properties of Inconel and also contains material on Inconel X, a newer age-hardenable nickel alloy. Both bulletins have charts, tables on compositions and properties, and working instructions. The International Nickel Co, Inc, 67 Wall St, New York 5, N. Y.

METERS AND INSTRUMENTS, MECHANICAL

T6 ENGINE INDICATOR — 2-page leaflet describes the Bacharach Type 4-HST Chronomatic engine indicator for high-speed engines. Bacharach Industrial Instrument Co, 7000 Bennett St, Pittsburgh 8, Pa.

T7 SMOKE CONTROL—8-page bulletin No. 501 describes Hackgage

(Continued on page 124)

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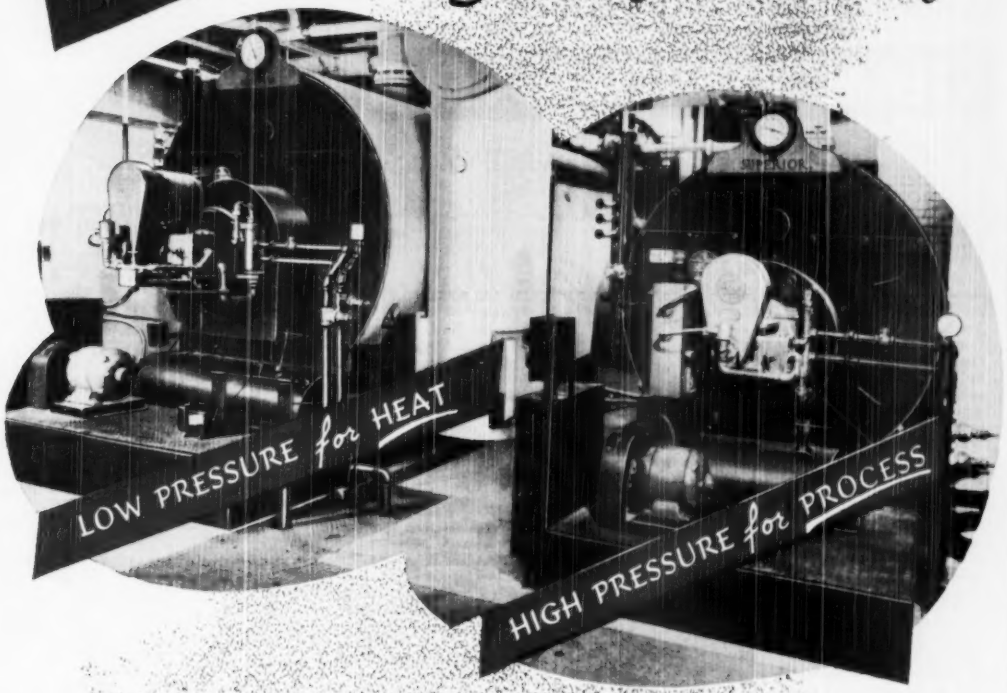

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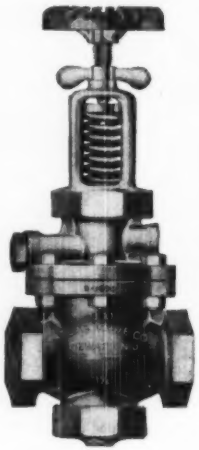
Type "B" is unequaled for services that require tight seating and uniform reduced pressure. With this remarkable STELLITED valve wide fluctuations in initial pressure have practically no effect on the reduced pressure because of the pilot operation. Renewable piston chamber, internal pilot valve and main valve strainers. Main valve disc seats tight because disc stem is guided by center bearing cast integral with seat ring. Control diaphragm and controlled pressure port are integral with the valve body. The main valve is caused to open wide and close tight with slight changes in the reduced pressure through the operation of the pilot.

This excellent valve is also simple to maintain. Main valve disc and pilot valve are easily removed for cleaning or regrinding. The entire pilot valve can be lifted out by merely removing diaphragm cap and unscrewing pilot valve seat.



For 250 lb. Service. Iron Body — Flanged Ends—Bronze or Nickel Alloy Seats and Valves—Pilot Operated. For initial working pressures from 20 to 250 lb. saturated steam: for reduced working pressures from 1 lb. to within 20 lb. of initial pressure in one stage. Sizes: 2½", 3", 4", 5", 6", 8".

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- ☐ Type "B" Reducing Valve
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T8 FLOW INSTRUMENTS—28-page catalog No. 50 describes developments in exhibiting and controlling flow instruments for all industries. Illustrated and described are flow indicators, recorders, integrators, and new pneumatic controller unit. Fischer & Porter Co, 50 County Line Road, Hatbori, Pa.

T9 TEMPERATURE AND PRESSURE INSTRUMENTS — 8-page catalog No. 86 illustrates and describes new measuring, exhibiting and controlling temperature and pressure instruments. Also descriptive data on Type 3 Pneumatrol unit with proportional band, automatic reset and derivative action control. Fischer & Porter Co, 86 County Line Road, Hatboro, Pa.

T10 THERMOMETERS—44-page bulletin No. T840 gives complete information on Series 500 line of thermometers. Liquid-filled, vapor pressure, and gas-filled types are described in models for recording, indicating, controlling, and telemetering of temperatures. The Bristol Company, Sales Promotion Dept, Waterbury 20, Conn.

PIPING, FITTINGS, VALVES AND SPECIALTIES

U9 STEAM HOOK-UPS—64-page enlarged edition of Sarco Steam Hook-Ups for steam traps, air vents, and industrial temperature controls, with additional technical information. Sarco Co, Inc, Empire State Bldg, New York 1, N. Y.

U10 PIPELINE STRAINERS—6-page bulletin No. S-203 provides data on Yarway screwed strainers, ¼ to 2 in., and expanded details on flanged strainers. ½ to 5 in. Yarnall-Waring Co, Mermaid Lane, Philadelphia 18, Pa.

U11 NON-RETURN VALVES—8-page bulletin No. S-1 gives informative data on cushioned triple acting non-return valves for steam control in case of damaged boilers or headers. Available in sizes 2 to 30 in. for pressures from 125 to 1500 psi. Golden-Anderson Valve Specialty Co, Keenan Bldg, Pittsburgh 22, Pa.

U12 PACKLESS EXPANSION VALVES —16-page bulletin No. R-35-51 explains design and construction of Corruflex, a corrugated packless expansion joint that requires no maintenance. Gives sizes, temperature and pressure ratings, dimensions and weights. American District Steam Co, North Tonawanda, New York.

U13 CONVERTORS — 12-page catalog No. 303 describes the company's D line of convertors designed especially for use with hot water heating systems. Documented with selection charts and tables. The Patterson-Kelley Co, Inc, 28 Wilson Ave, East Stroudsburg, Pa.

U14 ELECTRICALLY OPERATED TRAP—4-page bulletin ET gives data on the Johnson Electrap, an electrically operated trap for pumping or lifting service or for draining vacuum lines. Includes drawings of typical installations. The Johnson Corp, Three Rivers, Michigan.

PRIME MOVERS AND ACCESSORIES

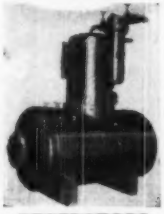
V1 HEAVY-DUTY DIESEL — 4-page bulletin No. 107 gives informative data on Murphy dual-fuel engines for burning natural gas or diesel fuel. Three models available ranging from 135 to 180 hp. Murphy Diesel Co, 5317 W Burnham St, Milwaukee 14, Wis.

V2 DUAL-FUEL DIESEL — 8-page bulletin No. 177 describes the Nordberg four-cycle Type FSG-16x16 in. Duafuel Diesel engine burning gas and oil, and built in supercharged or non-supercharged units. Nordberg Mfg Co, Milwaukee 7, Wis.

WATER TREATMENT

X2 DEMINERALIZING EQUIPMENT —Two bulletins offered. 2-page bulletin No. BFT-1 gives data on ex-

BOILERS



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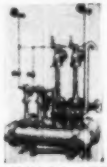

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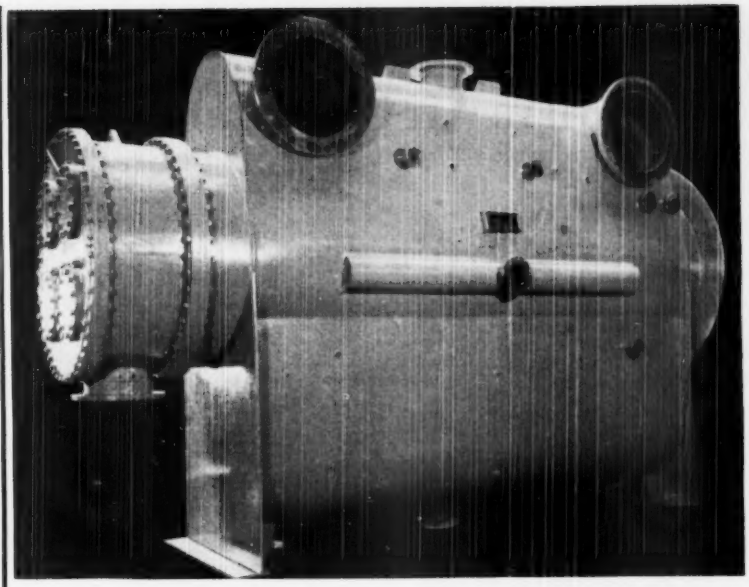

CONSECO CONDENSERS

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New York City - Staten Island Ferries

Shown above is a view of one of three 3,000 sq. ft. CONSECO Condensers for three new ferries between New York City and Staten Island, being built by Bethlehem Steel Company, for the City of New York.

Each condenser is a 2-pass, non-divided flow unit. Hotwells are of the full-deaerating type which eliminates the necessity for deaerating heater in the feed water cycle. Each condenser will serve a uniflow type engine. Special arrangements for condensate storage have been built into each condenser to take care of surges during ferry loading operations.

Other equipment aboard the ferries furnished by CONSECO includes Air Ejectors, Feed Water Heaters and Drain Coolers.

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CONSECO **Condenser Service & Engineering Co.**
HOBOKEN, N. J.

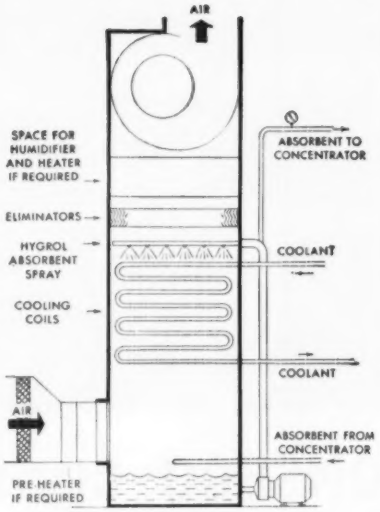
New Method Gives Precise Control in Air Conditioning

Niagara "Controlled Humidity Method" Uses Hygrol, Hygienic Liquid Absorbent

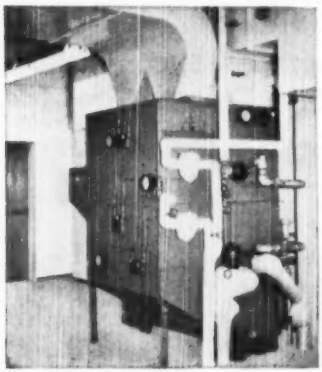
● The Niagara "Controlled Humidity Method" is a new system of air conditioning giving complete control of temperature and relative humidity, holding constant conditions or varying them at the will of the user. Especially, it provides dry air at normal atmospheric temperatures with little or no refrigeration required. A condition of 15 grains of moisture per pound of air at 85 deg. F. dry bulb temperature has been produced without refrigeration.

The apparatus is enclosed in a casing thru which the air is drawn by fans. The air is filtered and then enters a chamber where it is dehumidified in passing thru a spray of "Hygrol" Liquid (a hygienic hygroscopic chemical that absorbs the air-borne moisture and contains no salts or solids to precipitate) In the same chamber are located cooling coils which remove the latent heat of evaporation and also sensible heat as required.

The absorbent liquid spray falls into a tank at the base, where it is piped to a concentrator, removing moisture taken from the air. The re-concentrated liquid returns to the system. This process is continuous, and the apparatus operates at full capacity at all times.



NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM



The same equipment may be used to provide winter air conditioning when required, by installing a tempering coil at the outdoor intake, an humidifier, and a reheat coil above the eliminators.

This equipment is manufactured in a range of sizes providing from 1000 to 20,000 CFM of conditioned air from a single unit, and mutiple unit installations are practical. It is expected that, by reducing the need for refrigeration, the cost of air conditioning will be reduced by this method. Applications generally are in a temperature range from 35 deg. F. upward. Below the freezing temperature of water, the Niagara "No-Frost" method is applicable.

The equipment is protected by U. S. and foreign patents. Installations have been made in food and chemical process industries, in packaging hygroscopic products, for preventing condensation of moisture on metals and other products in storage, in air conditioning for laboratory control and for human comfort.

For further information, write Niagara Blower Company, Dept. P, 405 Lexington Ave., New York 17, N. Y.

(Advertisement)

ternal boiler feedwater treating equipment including both zeolite and chemical type water softeners, demineralizing equipment and silica removal equipment. Bulletin DM comprises five types of partial demineralizing equipment and various types of degasifying apparatus. Both bulletins include information on silica removal by ion exchange and the Hungerford & Terry UN-A-Bed demineralizing unit. Hungerford & Terry, Inc, Clayton, N. J.

X3 **THRESHOLD TREATMENT** — Folder discusses prevention of lime scale deposition by threshold treatment of water with Calgon, a vitreous sodium phosphate. Typical applications cited. Calgon, Inc, Hagan Building, Pittsburgh 30, Pa.

WELDING

Y3 **WELDING ELECTRODES** — 16-page booklet No. E 135-7 contains information on mild steel arc welding electrodes. Two pages of data on each of seven Murex electrodes meeting various AWS and ASTM rquirements for mild steel arc welding electrodes. Illustrated with performance charts and application photos. Metal & Thermit Corporation, 100 E 42nd St, New York, 17, N. Y.

Y4 **WELDING ACCESSORIES** — 32-page booklet No. E-138-10-550 covers the company's line of welding accessories such as holders, helmets, cable, ground clamps, goggles cleaning tools and protective clothing, giving descriptive data and specifications, also data on replacement parts. Metal & Thermit Corp, 100 East 42nd St, New York 17, N. Y.

OTHER EQUIPMENT

Z6 **INDUSTRIAL FURNACES** — 11-page bulletin No. HGF-101-12-46 gives informative data on direct-fired hot gas generating industrial furnaces in capacities from 600,000 to 100,000,000 Btu's and larger for process drying and product heating. Air Devices, Inc, 17 E 42nd Street, New York 11, N. Y.

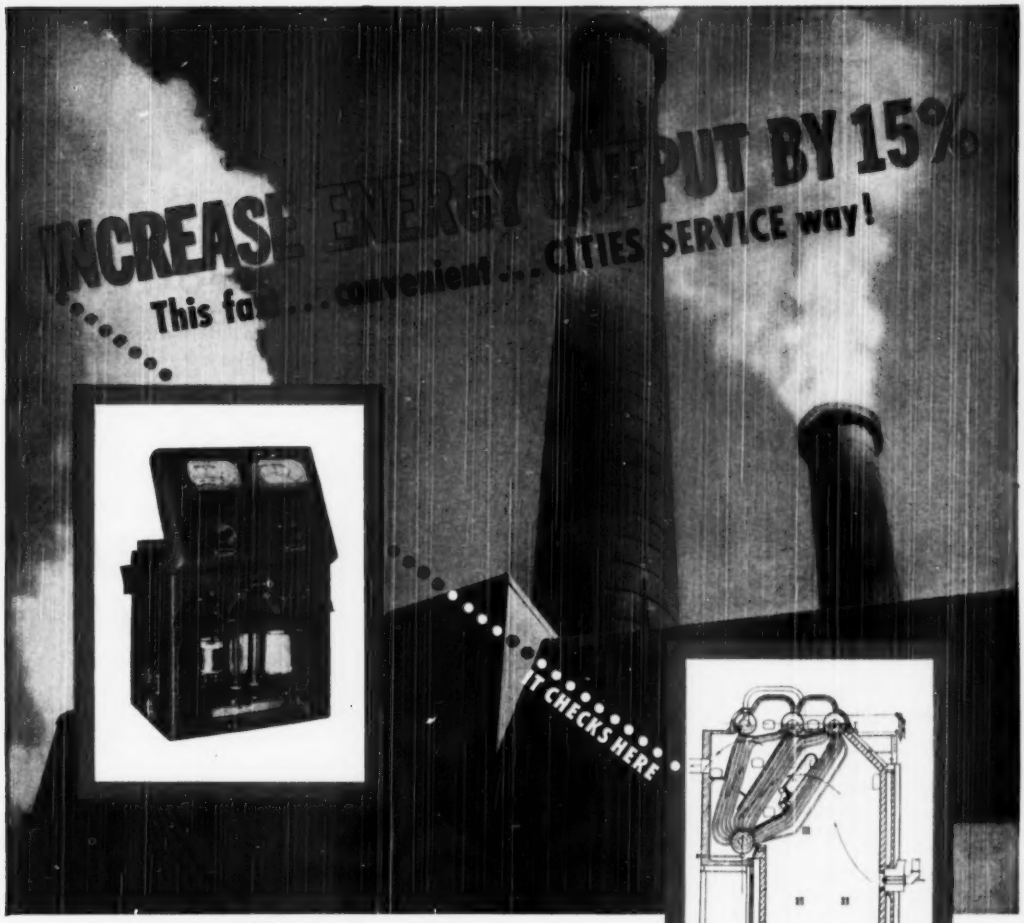
Z7 **TEMPERATURE INDICATOR** — 4-page catalog No. 501 describes the Tempil line of temperature-indicating products, Tempilstiks, Tempilaq, and Tempil pellets. Available temperature ratings cover the range from 113 F to 2500 F. Tempil Corp, 132 West 22nd St, New York 11, N. Y.

Z8 **PNEUMATIC ACCUMULATOR** — 4-page bulletin No. 400 deals with the causes of line shock or water hammer, discusses its characteristics, detrimental effects and provides a formula for determining the magnitude of shock occurring under any set conditions. Also explaines the use of the Hydro-Pneumatic Accumulator as a means for suppressing the line shock. Greer Hydraulics, Inc, 454 18th St, Brooklyn, N. Y.

Z9 **STEEL STAMPS**—4-page bulletin No. LF-50 describes Mecco Safety steel stamps for all types of industrial marking applications. Includes details on dimensions, character sizes and prices for the various sizes and styles. M E Cunningham Co, 183 E Carson St, Pittsburgh 19, Pa.

Z10 **HYDRAULIC GATES** — 2-page bulletin No. GH-5-48 gives data on the Murray line of gate hoists designed and built to meet all requirements from less than 1 ton to over 100 tons. D J Murray Mfg Co, Wausau, Wis.

Foreign-aid policy should embrace all non-communist areas, **William E Knox**, president of **Westinghouse Electric International Co**, told the 18th annual convention of the Edison Electric Institute. The current hot spot in the cold war is Asia where half the world's people live on less than one-tenth the world's land. Knox recommended that all foreign aid in Asia be spent on a regional basis, such as is the case in Western Europe.



The Cities Service Industrial Heat Prover

This remarkable instrument is an exhaust gas analyzer, designed for use on industrial furnaces regardless of size or type. It is provided with three scales; one shows per cent of oxygen, another percentage of combustibles present and measured in the flue gas sample, and the third scale registers flue gas temperature.

A fuel analysis taken at this important checking point—during a free demonstration—has led to increases in energy output as high as 15%. The Heat Prover indicates the type of adjustments necessary to get maximum combustion efficiency.

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NOW CLEAN GENERATORS MOTORS Without Solvents

NO Drying Period Toxic Hazards

with New Pangborn AC-4 Blast Machine

NOW YOU CAN clean electric motors, generators and turbines *without solvents!* The new Pangborn AC-4 Blast Machine scours armatures, parts, frames, coils, etc. with soft (20-mesh) corncob grits.

Since no liquids are used there is no need for drying periods and toxic or explosive hazards are eliminated. Large equipment can be cleaned *in place* and no residue is left to create gum or to break down insulation.

Simple and Inexpensive

New Pangborn AC-4 Blast Machines operate from a standard 40-pound air supply. Material costs average 1/10 of other methods and complete cleaning is finished in half the time.

FOR DETAILS, write today outlining your operation. Address: PANGBORN CORPORATION, 90 Pangborn Blvd., Hagerstown, Maryland.

Look to Pangborn for the Latest Developments in Blast Cleaning and Dust Control Equipment

Pangborn

BLAST CLEANS CHEAPER with the right equipment for every job

POWER NEWS

(*Continued from page* 140)

to charge blast holes and a mobile telescopic platform for inspection. A standard 3-yard electric shovel, with a shortened boom, and 15-ton diesel trucks load and transport the broken shale from the mine.

Thirteen men operate the equipment for one unit of a commercial large-scale mine on the 27-ft-high by 60-ft-wide top level advance headings. During production-test runs, rates of 148 tons per man-shift underground labor and 116 tons per man-shift total labor have been made. They are the basis for the 29c per ton price quoted.

Pumping Plant Uses Large Motors

General Electric will supply about $350,000 worth of electric equipment for the new Hudson River Pumping Station being built by New York City's Board of Water Supply at Chelsea, N. Y., about 10 miles south of Poughkeepsie.

Designed to augment the dwinding water-shed resources of the nation's largest metropolis, the station will have a discharge rating of 100 mgd (million gallons a day). Water will be taken from the Hudson River through a 6-ft conduit and discharged into the existing Delaware Aqueduct. In the conduit the water will be chlorinated and will go into the city's regular 13½-ft water-system conduit.

Each of six Peerless pumps to be installed at the station will be powered by a 2500-hp vertical synchronous motor. Five of the pumps will be used to meet the 100-mgd rated capacity, while the sixth will be a spare.

A package-unit substation for the project is rated 15,000 kva, 3 phases, 60 cycles. A single incoming 110,000-v circuit will supply the plant, stepped down to 4160 v. It is expected that all electric equipment will be shipped by Sept 1.

Gas Turbine Ordered For Vermont Utility

A new 6000 kw gas turbine power plant for the Central Vermont Public Service Corp is scheduled for the city of Rutland, Vt.

Preliminary work was to get underway by July and the plant is expected to go into operation by June 1951. The plant will be placed on a tract of land just north of the junction of Otter Creek and East Creek about a half mile south of U S Highway 4 leading west from Rutland.

General Electric Co will supply the gas turbine.

There's always room and big pay in POWER

Here's the information you need to equip yourself for a better job

Hundreds of men are using this practical library to reach the top in the power plant field. It brings you a complete education in power plant practice; it packs between the covers of 6 concise volumes a wealth of information on boilers, steam engines, steam turbines, pumps, boiler-feed apparatus, etc. Not only do you get the "how to" of every phase of power plant work, but this library gives you the fundamental principles in back of each phase and tells you "where," "when," and "why" a job should be done in a particular way.

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By TERRELL CROFT

6 volumes, 2477 pages, 2404 illustrations

Here are the results of years of experience with power plant problems . . . an accurate on-the-job guide to getting the right answers quickly and with remarkable ease. The Library of POWER PLANT PRACTICE is the one standard reference work in the field . . . the set you can turn to with confidence on any power plant problem.

Covers power plant work inside-and-out

Every important division of power plant practice is explained for you in a clear, easy-to-understand way . . . from the selection of engines to the operation of electrical equipment . . . from a basic, clear explanation of the "stickers" you meet up with in your work to analyses and solutions to the big troublesome problems . . . all plainly worded and explained with clear illustrations. Every page is packed with the kind of information that the power plant man wants and needs in his daily work.

6 powerful self teachers

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2. Steam Engine Principles and Practice
3. Practical Heat—Part I
4. Practical Heat—Part II
5. Steam Turbine Principles and Practice
6. Steam Power Plant Auxiliaries and Accessories.

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With a little spare-time reading you can have the identical knowledge possessed by the highest paid engineers. They make big money because they know Power Plant Practice from A to Z . . . here's your opportunity to join their ranks! Return the coupon below and we'll send you all six books for 10 days' free examination. After 10 days you are free to return the books without obligation . . . or, if you decide to keep them, to pay in easy monthly installments as outlined below.

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STANDARD OIL COMPANY (INDIANA) Power Plant, serving a refinery at Wood River, Illinois. Built during World War II, it is one of a number of large-scale facilities constructed by Dravo to satisfy the varied power needs of many diverse industries.

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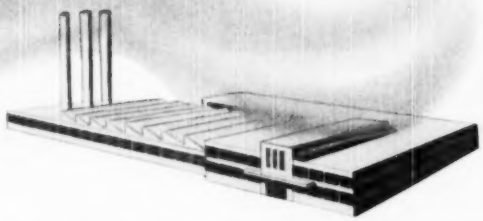
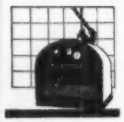
CARDOX SYSTEMS* are making Industry SAFER than ever before!





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Today's central stations demand fire protection that will stop fire ***before*** it becomes a major disaster. It is significant that such a large percentage of the country's leading power plants rely on CARDOX Systems and equipment for that kind of fire protection!

It was CARDOX who broadened fire protection horizons by pioneering and making available low-pressure carbon dioxide for fire protection. For many years the systems and equipment using this more effective, non-damaging extinguishing agent have been engineered, manufactured and installed by CARDOX. New methods, new viewpoints, new techniques—all have been perfected by CARDOX through never-ending research. Today CARDOX is the undisputed leader in fire extinguishment and prevention by means of low-pressure storage and mass application of this inert miracle gas.

Savings to Utilities have been enormous—in fires prevented and in lessened loss of operating time and equipment in cases of actual fire.

Have your secretary write for "WHERE THERE'S SMOKE," an interesting booklet about fire hazards, sent gratis to executives and fire protection men.

*Low-Pressure Carbon Dioxide Fire Extinguishing Systems covered by Cardox patents issued and pending.

CARDOX CORPORATION

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Technical Briefs

(*Continued from page* 192)

This paper deals with the factors involved in determining (1) capacity benefits resulting from interconnecting several generating systems, as one justifying factor for the interconnection (2) the installed capacity obligations of the interconnecting system. In addition, the paper gives what is believed to be a logical and equitable basis to determine such obligations.

The author draws the conclusion that the capacity benefits from the interconnection of two or more electric-generating systems can best and most logically be evaluated by probability methods. Such methods are most accurately allocated among the systems participating in the interconnection by "the mutual benefits method of allocation," since it is based on benefits usually contributed by the several systems. *AIEE paper. No.* 50-188.

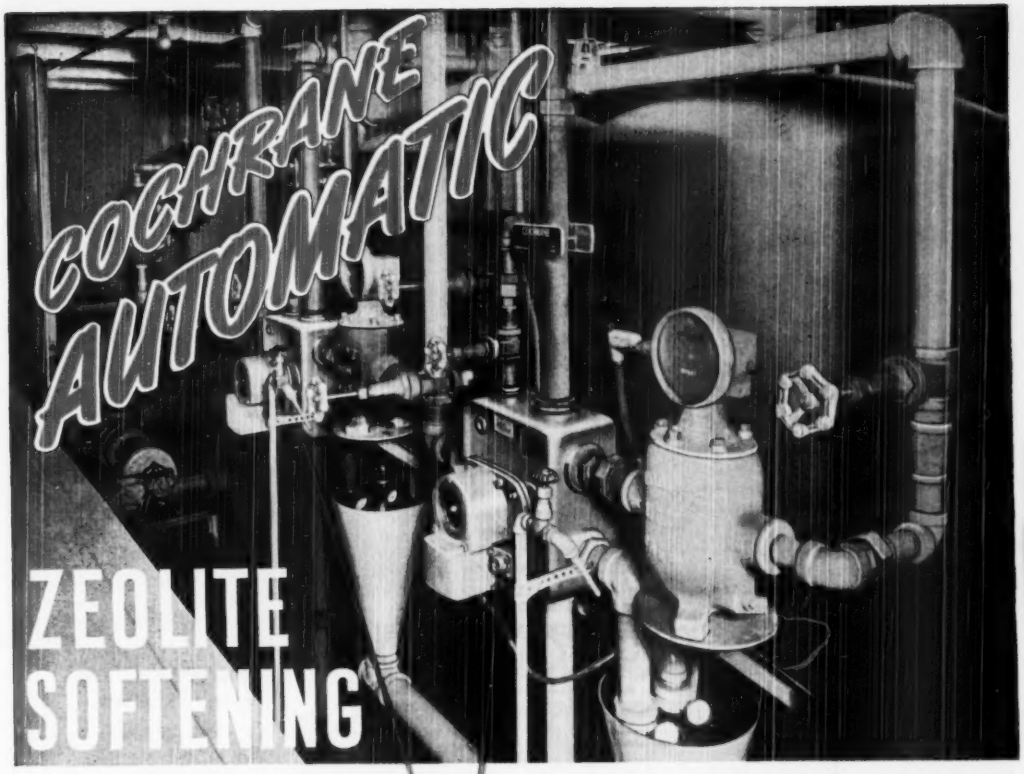
Smoke Prevention

TESTING FOR FLYASH EMISSION BY THE SMALL STEAM PLANT, *by Philip F Best, Thermix Corp.* There is a general feeling that testing for flyash emission takes too much time and equipment for the small boiler plant to tackle the job. The author feels this is not true and information you get from such a test is well worth the effort.

The day when smoke- and dust-control ordinances were aimed at only the large plant is a thing of the past. Unfortunately there is no hard and fast rule that definitely defines who is and who is not an offender in flyash emission. Actual testing is the only sure way to establish innocence or guilt.

The *ASME Power Test Code* for fluedust sampling covers both a carefully run test for large utility and similar plants, and simpler tests for small plants. Unfortunately, the various alternates have created confusion. Basic requirements for an adequate test are: (1) as good a location as possible—usually this is a compromise to avoid fan inlets, outlets, duct bends, etc (2) the same velocity in the test nozzle as in the duct (3) some filtering medium to remove sampled dust from the gas with good efficiency (4) summary of results to make comparisons and conclusions.

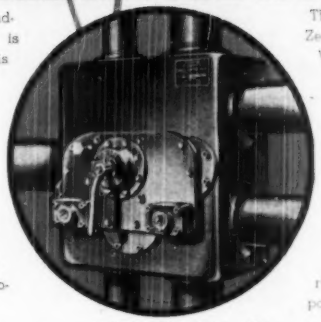
The author then describes several test apparatus that meet the above four needs. By suitable illustrations and charts he helps set some of the values for pipe or duct dimensions, orifice calibration and other data. *SPAA paper. No number. Available from the author, Thermix Corp, Greenwich, Conn.*



with the COCHRANE HYDROMATIC VALVE

The new Cochrane Hydromatic Valve, standard equipment on Cochrane Zeolite Softeners, is readily adaptable to automatic control. This is a fact of prime importance to any user of zeolite softeners for, with the Hydromatic Valve, no change in the physical plant is necessary—merely the simple addition of a control box and a small drive motor.

Automatic operation of Zeolite Softeners makes possible economies in the amount and cost of the zeolite materials that often offset the cost of the control accessories, aside from the convenience of the automatic operation.



The points in favor of Cochrane Automatic Zeolite Softening System with the Hydromatic Valve are these:

1. Simplest and most positive single control valve ever built—six valves in one.
2. Automatic Control with the Hydromatic Valve means merely the addition of control box and a small 1/30 H.P. drive motor—no changes in the physical plant.
3. Cost of labor attendant on manual operation is eliminated.
4. No objection to shorter regeneration period permitting savings on amount and capacity of zeolite materials.

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Please send me a copy of your latest bulletins on Zeolite Softeners and the Hydromatic Valve.

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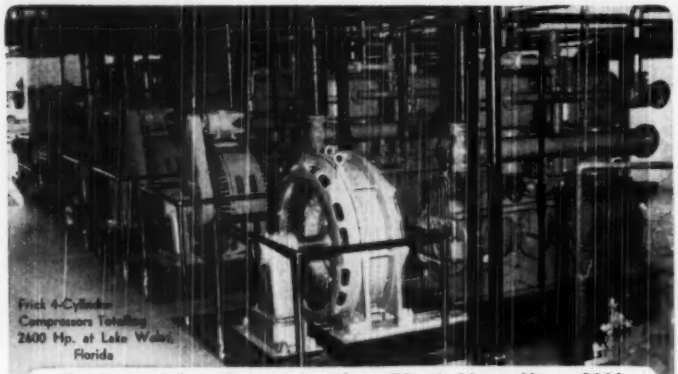


Frick 4-Cylinder Compressors Totalling 2600 Hp. at Lake Wales, Florida

Orange Juice Concentrating Plant Now Uses 3180 Horsepower of Frick Refrigeration

The Florida Citrus Canners Cooperative at Lake Wales, largest of its kind in the world, depends on this battery of six Frick refrigerating machines for heavy-duty heat-pump service.

Hot gas, discharged from the compressors, heats the orange juice, driving off excess moisture as low-pressure steam. This is condensed by the "cold" side of the refrigerating system, and the heat is efficiently recovered.

Nine other Frick compressors chill, quick-freeze, and store the concentrated juices.

The original capacity of the plant has increased nearly six times over, in two years.

Frick equipment was the pioneer and is the recognized leader in this new field. Whether you need air conditioning, ice-making or refrigerating equipment, you get the most satisfaction and economy from machinery carrying the Frick trademark. Let us submit estimates on your requirements.

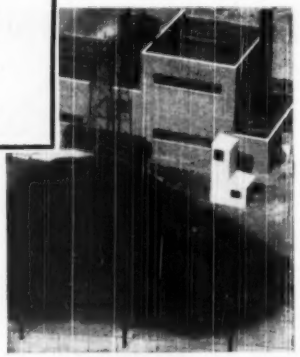
DEPENDABLE REFRIGERATION SINCE 1867

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

Also Builders of Power Farming and Sawmill Machinery

Store and reclaim your coal for a few cents a ton



Sauerman Scrapers are handling coal at many plants for as little as 2¢ per ton for each move into or out of storage. This operating economy is just one of many reasons why SAUERMAN Scrapers have become the most widely used equipment for open storage of coal. Other advantages are:

- Machine is simple and easy to operate. From a point overlooking the storage area the operator guides every move of the scraper through a set of automatic controls.
- The equipment is adaptable to any ground regardless of the shape or condition of the area.
- Scraper piles coal in compact layers. There is no segregation of lumps and fines; no air pockets to promote spontaneous combustion.
- Each SAUERMAN installation is a permanent, trouble-free investment. Upkeep is easy.

The Brantley Steam Station of the City of Danville, Va. completed in 1949, uses a 1 cu. yd. Sauerman Power Drag Scraper to store and reclaim its reserve coal at a rate of 36 t.p.h. Picture shows start of storage.

If you have a coal storage problem write for the Sauerman catalog.

SAUERMAN BROS., INC.

562 S. Clinton St. Chicago 7

SAUERMAN

POWER SCRAPERS FOR STOCKPILING

Mechanical Vibrations

(*Continued from page 89*)

turbine-generators. It takes considerable time to stop and start the unit and vibration vectors change for several hours after starting. One balance move a day, rather than two, gives better results. This allows time for the unit to "straighten out" and reach a stable condition. Two vibration readings taken an hour apart should agree before planning the next move.

It often happens on turbine-generators that after running several weeks, vibrations as left reduce to about half the value. Of course, sometimes vibrations increase. I believe these slow changes are caused by gradual easing of strain in the bearing supports and steel work.

My experience has shown that bearings higher than they should be, have a small angle of lag with the shaft and vibrations approaching the shaft values. Low bearings show large angles of lag (180 or more) and vibration readings less than the shaft. I have raised and lowered bearings on such evidence and always obtained the expected result.

Incremental Load

(*Continued from page 117*)

with 95 mw on the turbine strip and find 10,100 turbine rate and 6.8 on the proportioning scale. The corresponding boiler increment rate is then:
$1.20-(1.20-1.09)\ (6.8/7.9) = 1.105$.
With these values we can find the station incremental rate by the formula.

The next block of 10 mw brings us to 105 mw total load. The turbine strip shows that this should be taken on turbine *A*. But this unit is out of service, so it must be eliminated from the strip setting. Rotate the entire drum to line up the bottom of the 10,360-A block with the index. Then move the turbine strip only, downward past the three 10-mw *A* blocks all labeled 10,360. We then have the strips in the position shown in Fig. 8.

Now the 105-mw load will be found in the middle of the *C* block at 10,390 Btu increment rate. At this point the proportioning scale reads 4. This makes the boiler increment rate equal to
$1.20-(1.20-1.09)\ (4/7.9) = 1.144$.

In this way we can proceed up the load scale, eliminating equipment out of service as we go along. The shaded areas in Fig. 6, 7 and 8 show the blocks eliminated.

Our experience has shown that nontechnical personnel can be trained to run the computer in a very short time. Steps are easy to follow and quick to execute. The matched values are recorded in a table as shown in Table I.

TERRY

QUICK-STARTING
TURBINE
FOR FEED PUMP
EMERGENCY DRIVE

The turbine shown at the right picks up the feed-pump load in case the motor, which normally drives the unit, is inoperative. Thus the turbine must be able to start quickly and be completely reliable —characteristics which are assured by the generous blade clearances and one-piece construction of the Terry Wheel.

This is but one example of many special turbine requirements that are met by the Terry solid-wheel turbine. Details on how this and other Terry Turbines will meet your individual needs will be gladly supplied by a Terry engineer.

DATA

The turbine is 620 hp, 3550 rpm for 850 psi, 900F steam with 2.5 psi back pressure.

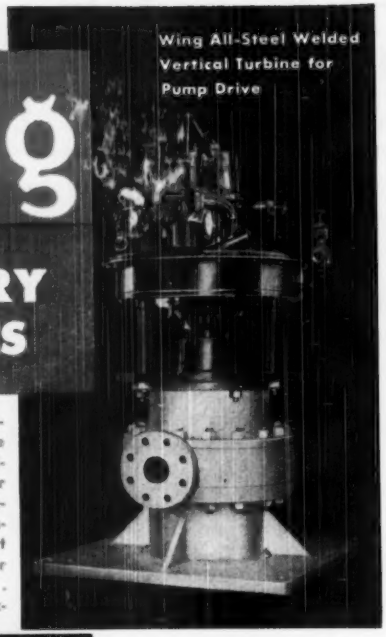
Installed in the Crawford station, Middletown, Pa., Metropolitan Edison Co. Gilbert Associates, Inc. were the consulting engineers.

T-117H

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Wing

AUXILIARY TURBINES



Wing All-Steel Welded Vertical Turbine for Pump Drive

Rugged, compact, and dependable Wing Auxiliary Turbines are the most adequate and economical means of supplying power for many industrial and marine requirements. Their many advantages include low operating cost . . . elimination of electric power . . . lower maintenance costs . . . and the fact that the oil-free exhaust steam resulting from their operation may be used for other purposes, such as heating, process work, etc.

Wing Steam Turbine for Auxiliary Drive

In over fifty years of service Wing Auxiliary Turbines have amply proved their ability to stand up under the most rigorous service as prime movers for mixers, marine gear, pumps, fans, winches, generators, compressors, and other equipment. Their long record of consistently trouble-free performance has resulted in increasing acceptance of Wing Auxiliary Turbines as a source of power in many applications formerly using motor drive.

For further information on Wing Auxiliary Turbines write for Bulletin SW-48

L. J. Wing Mfg. Co.

50 Vreeland Mills Road
Linden, N. J.

Factories:
Newark, N. J. • Montreal, Can.

Wing Turbine and Gear Combination on common pedestal base

APPOINTMENTS

Air Reduction Sales Co., a division of **Air Reduction Co, Inc,** has been appointed national distributor for the welding industry for the recently introduced Prepo Torch.

Charles L Haslup recently took over the post of sales manager for R-P&C Valve Div of **American Chain & Cable Co, Inc,** with headquarters at Reading, Pa.

Air Preheater Corp announced that W H Larkin had joined their New York sales organization. He was formerly with Sturtevant Div of Westinghouse Elec Corp in charge of power plant work.

Titus G LeClair, assistant electrical engineer, Commonwealth Edison Co, Chicago, has been elected president of the **American Institute of Electrical Engineers.**

Changes recently announced in the **Allis-Chalmers Mfg Corp** include J H Burrus to manager of the Milwaukee district; U E Sandelin, Portland district, S C Bacon, Seattle, in the general machinery div, and M M York, Boston district sales.

Bendix Corp announced that Capt Howard T Orville, Navy aerologist, is returning voluntarily to head up the engineering div for Friez Instrument div of Bendix Aviation Corp.

Board of directors of **Bituminous Coal Research Inc,** elected A A Potter, dean of engineering, Purdue Univ, to the presidency of B-C-R on a part-time basis. R H Sherwood will again be first vice-president.

Warner Gear Div, **Borg-Warner Corp,** appointed R R Rolph as Detroit sales representative.

H B Brown, Jr, of Washington, D. C., has joined the public relations staff of the **Bituminous Coal Institute.**

Brown-Boveri Corp has been appointed U.S.A. distributor for F R Sauter Electrical Apparatus Mfg Co of Bach, Switzerland.

Hewett A Gehres, executive vice-president **Cooper-Bessemer Corp,** was awarded the honorary degree of Doctor of Science by the Grove City College.

Cyclotherm Corp recently elected David Thomson, president, David Thomson Assoc, to fill a vacant spot on its board of directors.

Chain-Belt Co has selected Bush-Brehner, Inc, York, Pa., Stacy Supply Co, Springfield, Mass., and Klamath Machinery Corp, Klamath Falls, Ore., as its distributors in their areas.

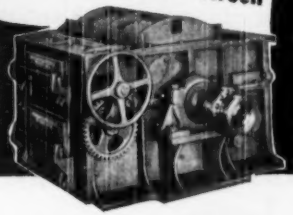
Additions to the field sales staff of **Combustion Control Corp** include Stanley J Pachuyn, assistant sales manager, Chicago; Rody N Capron, west coast sales manager, San Francisco, Calif.; Dan A Fisher, formerly in Cambridge, Mass., to New York City.

Ralph L Boyce, vice-president and chief engineer, **Cooper-Bessemer Corp,** and

FOUR MILLION TONS OF COAL CRUSHED

with a parts replacement cost of only $.0005 per ton

AMERICAN AC3-E CRUSHER
in continuous service for 10 years
reduces 300 TPH 6" x 1¼" washed coal to 100% passing 1¼" screen



AT THE LITTLE SISTER COAL CORPORATION (St. David, Ill.)

. . . this crusher is giving a performance that is typically American—*typical* because American Crushers are engineered to "take it," and are *tested in actual use.* They slash power and labor costs too, and cut out-of-service time to a minimum. *Here are a few construction "whys" behind American records—*

THE HEAT TREATED ALLOY STEEL MAIN ROTOR SHAFT—revolves on heavy duty Timken Bearings enclosed in dust and oil-tight pillow blocks. *Perfect balance eliminates vibration.*

THE HEAVY RIBBED SECTIONAL FRAME—Cast Steel—permits *accessibility and adjustability* . . . bearing pedestals are cast integral with side frames to assure rigidity.

THE ALL-MANGANESE STEEL CRUSHING PARTS include renewable Breaker and Grinding Plate, also Crushing Chamber cheek liners. Grinding Plate is adjustable to compensate for long wear.

REVERSIBLE SHREDDER RINGS
In reducing coal by *controlled cleavage* (instead of by crushing), these 20-edge manganese steel rings give uniform, high tonnage reduction, with a minimum of degradation, operating at slow (275 to 350 RPM) power-saving speeds.

Let an American representative analyze your crushing problem. Also, we'll be happy to send you our bulletin "Crushing Coal at Less than One Cent Per Ton."

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE.
ST. LOUIS 10, MO.

For **STRENGTH** specify

TRI-LOK

RECTANGULAR

OPEN STEEL FLOORING

The locked-in strength of Tri-Lok enables it to stand up under heavy loads—even on long spans. No rivets, bolts, or welds are used in the construction of Tri-Lok; this feature eliminates the possibility of loose joints.

Tri-Lok is also available in Diagonal, or Super-Safety U-type Flooring, and in Stair Treads of all types. Write for Bulletin KM 1140.

DRAVO CORPORATION

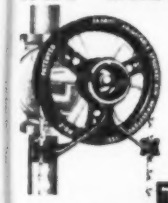
National Distributor for the Tri-Lok Company

Dravo Bldg., Pittsburgh 22, Pa.

Sales Representatives in Principal Cities

DRAVO

WHY WASTE STEAM?



Equip HARD-TO-REACH VALVES with Low-Cost

Babbitt —Adjustable— SPROCKET RIM with Chain Guide

• Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 38 inches.

• Much steam is wasted in industrial plants because overhead, out-of-reach, inaccessible valves either remain untouched and open, or are subject to hit-or-miss control. Turn this waste into dollars saved. Put those valves to work by getting the low-cost BABBITT Adjustable Sprocket Rim with Chain Guide. Valve control thus becomes easy, quick, regular—right from the floor!

• The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

• *Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.*

BABBITT STEAM SPECIALTY CO.

1 Babbitt Square, New Bedford, Mass.

W E Stevenson, president, Oberlin College, were elected to Cooper-Bessemer's board of directors.

John E Jass is the new assistant chief engineer for the **Caterpillar Tractor Co**; T M Logan joins the service dept; C L Kepner takes Jass' old position as supervisor of cable controls, etc; Randall Remar becomes supervisor of specifications; Paul B Benner, supervising engineer of tractor chassis; Richard S Frank, general supervisor of the five engineering dept divisions; W G Johnson, assume somes of Frank's former duties.

J Flingemen takes over the duties of manager of purchases and production for the **Dearborn Chemical Co**; W A Lutsch becomes manager of other Detroit branch office.

Dayton Power and Light Co promoted K G Oxley to manager of electric operations and R P Isenhart to manager of purchasing and stores.

Detroit Stoker Co has promoted Herbert L Wagner to vice-president in charge of engineering, with headquarters in Detroit.

Thomas S Agramonte, manufacturer's agent, Havana, Cuba, will represent **E F Drew & Co, Inc**, power chemicals div in Cuba.

De Laval Steam Turbine Co appointed Wilkinson & McClean, Ltd, of Calgary, Alberta, Canadian sales representative for Alberta province.

Electric Products Co have appointed K I Clisby Associates district representatives for eastern Pennsylvania, southern New Jersey, most of Maryland, all of Delaware.

Rotary compressors for refrigerators manufactured by **Fuller Co** have been taken over for national distribution by Freezing Equipment Sales, Inc, York, Pa.

Hardy S Ferguson, noted paper and pulp industry engineer, joins the pulp and paper engineering div of the **H K Ferguson Co.**

Fairbanks, Morse & Co have made Gordon R Anderson general manager of their Freeport Works to succeed Lee Madden, now retired. Donald L Harwood has been appointed purchasing agent.

W B Farnsworth, formerly merchandise manager, becomes assistant to the president of **Georgia Power Co**, to succeed C S Hammond who died May 19.

A P Green Co purchased the Valentine Fire Brick Co, Woodbridge, N. J.

James P. Raugh was elected vice-president of the **General Refractories Co.**

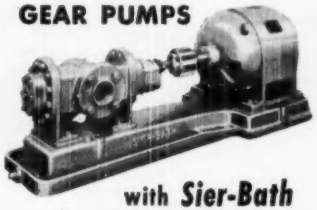
Harold B Leland has been appointed vice-president of manufacturing for **Hood Rubber Co**, a division of B F Goodrich Co.

Ironton Fire Brick Co has made James H Rickey, Jr, formerly production manager, new sales manager.

PUMP FUEL?

Get These

4 BIG ADVANTAGES OVER GEAR PUMPS



with *Sier-Bath*

SCREW PUMPS!

❶—LONGER LIFE, LASTING EFFICIENCY. No metallic contact between rotors or between rotors and casing. Original rotor clearances maintained by precision cut timing gears.

❷—LONGER BEARING LIFE. Low radial load because flow is axial. No thrust load because ends-to-center flow is perfectly balanced.

❸—LESS STRAIN ON VALVES AND PIPING. Minimum cavitation because pump reduces velocity change. Eliminates hammer, vibration.

❹—NO SHUT-DOWN FOR RE-PACKING. Only suction pressure on stuffing boxes. Pump can be kept in operation while packing is added.

ADDITIONAL ADVANTAGES

- **Self-priming**
- **Pulseless discharge**
- **Direct-connected up to 1200 RPM**

If you are not now capitalizing on these advantages—don't fail to ask us for further details. We can supply you with Sier-Bath Screw Pumps perfectly adapted to your particular needs.

AVAILABLE IN TWO GENERAL TYPES: Internal Bearing Type (illustrated) for Lubricating Liquids; External Bearing Type for Non-lubricating Liquids. CAPACITIES: 1-700 GPM; DISCHARGE: 1000 PSI for viscous liquids, 250 PSI for water.

SEND FOR BOOKLET

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GEAR and PUMP CO., Inc.

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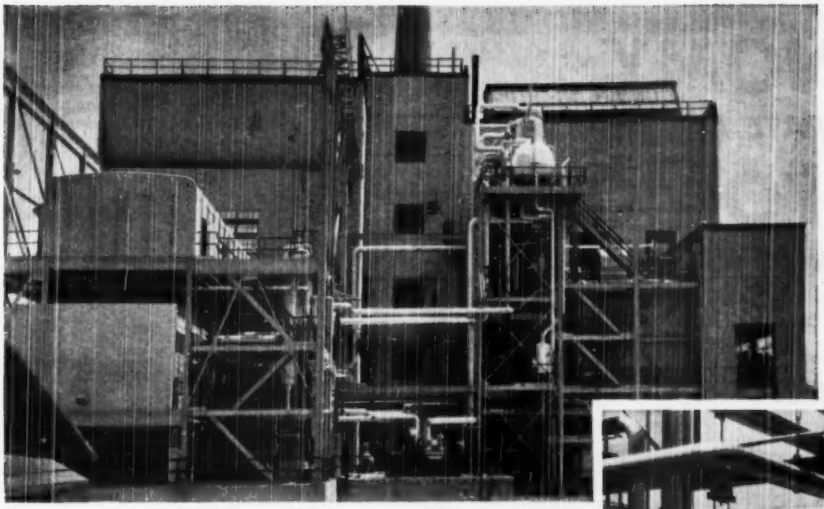
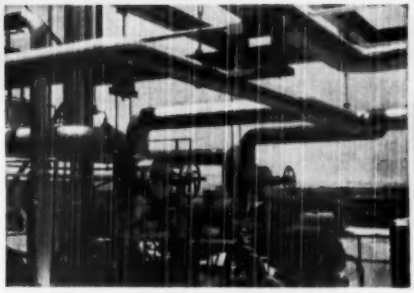


Engineers,
Stone & Webster
Engineering Corp.,
Boston, Mass.

Insulation Contractor,
Willard A. Selle, Inc.,
El Paso, Texas



El Paso Electric Company efficiently conserves heat with K&M INSULATIONS

IN 1948, the El Paso Electric Company extended its Rio Grande Power Station to add 20,000 Kilowatts to the existing plant's 46,000 Kilowatt capacity. Boilers, piping, and other heated surfaces were insulated with K&M "Featherweight"® 85% Magnesia for temperatures up to 600° F., and with K&M Hy-Temp Combination for temperatures in excess of 600° F.

K&M "FEATHERWEIGHT" 85% MAGNESIA

for temperatures to 600° F.

For more than 60 years K&M "Featherweight" 85% Magnesia Insulation has demonstrated its ability to conserve heat efficiently in power plants, oil refineries, chemical plants, factories, steamships and hospitals. In fact, wherever exacting requirements must be maintained for temperatures up to 600° F., "Featherweight" 85% Magnesia can be used with complete confidence. It combines the high insulating qualities of basic carbonate of magnesia with clean asbestos fiber as the binding element.

K&M HY-TEMP COMBINATION

for temperatures to 1900° F.

K&M Hy-Temp Combination Insulation is used for temperatures in excess of 600° F. and up to 1900° F.; combines the greater insulation efficiency of "Featherweight" 85% Magnesia with the high heat resistance of Hy-Temp.

Your K&M Distributor will be glad to give you complete information on K&M "Featherweight" 85% Magnesia Insulation, K&M Hy-Temp Combination Insulation, or other insulations in the K&M line. Or, write us.

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ECONOMY

AT MODERATE INITIAL COST

100 TO 4000

HORSEPOWER RANGE

600# GA., 750° F.

STEAM PRESSURES

MURRAY

STEAM TURBINES

TYPE UV MULTISTAGE

The Type UV Multistage Turbine is available in from two to ten pressure stages making Multistage steam economy available at moderate initial cost. Horsepower range is from 100 to 4000, steam pressures up to 600# ga., 750° F., condensing or non-condensing. Several governors and accessories adapt UV Turbines to practically any mechanical drive within the capacity range.

Pictured is a 5 Stage UV Turbine developing 325 HP at 6200 RPM operating condensing. Turbine is equipped with variable speed oil relay governor, pressure lubrication and vacuum breaker, and is in use driving a centrifugal compressor for refrigeration.

Contact your Murray representative for prices and engineering information or write for Bulletin T-122.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

E M Platts, sales vice-president, succeeded the late Arthur S Knoiser as executive vice-president of the **Joy Mfg Co.**

Jerguson Gage & Valve Co formed an English company in collaboration with Tress Engineering Co to merchandise and service their products on a world-wide basis.

I-T-E Circuit Breaker Co has formed a small-circuit-breaker div under F G Schmidt as manager.

J Lawrence Kennedy recently became secretary and vice-president of **Kennedy Valve Mfg Co** and a member of the board of directors.

Lunkenheimer Co appointed M W Pauley New York manager. Fred N Berling, advertising manager, retired July 1 and his department will be consolidated with the sales department.

Power Equipment Co of Kansas City, Mo., will represent **Lima-Hamilton Corp** in western Missouri, Arkansas, Oklahoma, New Mexico, Kansas, Colorado, Iowa, Nebraska, Minnesota, North and South Dakota on sales of their new Hamilton 21½ x 27½-inch diesel.

A complete new division of the **Laclede-Christy Co,** Laclede Arch Co, has been formed with engineering and sales headquarters in Chicago. W A Shipley will be president.

Graybar Electric Co appointed W E Henges, Cleveland district manager, assistant to the president. C E Kirkpatrick, manager of the Memphis branch, succeeds W E Henges in Cleveland; J W Horne takes over at Memphis, Wm McNulty has been named manager of the Syracuse branch.

George E Burens, manufacturing manager, General Electric Co's affiliated manufacturing companies dept, has been named general manager of **Locke, Inc.**

General Electric Co announced several changes in personnel and responsibilities. They include: H D Beale, to manager of renewal parts div of the Industrial div; Floyd C Pickett, to assistant to the works manager, Fitchburg, in the apparatus dept; Dr Lewi Tonks, physicist in the research laboratory to head of the physics div of the atomic power laboratory; in the small and medium motors div, D E Moorhead to administrative assistant to the manager; O F Vea to manager of sales; F B Hornby to manager of engineering; J P Keller, formerly supt of all generator and turbine bucket manufacturing to assistant to the manager, Industrial div, and L E Newman, assistant manager of turbine and gear sales div to replace Keller; Robert S Neblett to assistant manager of sales, turbine div; F L Headley to assistant manager, Pittsburgh apparatus sales office, N L Whitecotton to manager of Philadelphia apparatus sales, F I Kittredge to manager of Philadelphia apparatus sales office, industrial customer div, W C Mason to Atlantic district manager of the agency and resale

COMPLETELY DEIONIZED WATER IN ONE PASS THROUGH ONE UNIT!

Get full details of the technique that's revolutionizing water treating.

Once through a *single* bed of AMBERLITE ion exchange resins, and your water supply is rid of silica, carbon dioxide, calcium—*all* ionized solids!

AMBERLITE Monobed deionization is fast replacing multiple-bed methods of producing high quality water for boiler feed, electroplating, deposition of phosphors, washing of photographic film.

The column on the right will tell you *why*.

Consulting engineers and manufacturers of water conditioning equipment can tell you *how* Monobed deionization insures the life and efficiency of your boilers, improves your process and your product.

Our new 12-page booklet tells you *what* AMBERLITE Monobed deionization is. Write to Dept. PI-8 for your copy—today.

AMBERLITE Monobed Deionization Offers You . . .

1. Low equipment costs
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4. Uniform performance in intermittent service
5. Controlled quality of effluent

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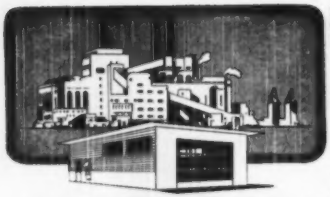
ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square Philadelphia 5, Pa.

The Resinous Products Division was formerly The Resinous Products & Chemical Company

AMBERLITE *is a trademark, Reg. U. S. Pat. Off. and in principal foreign countries.*



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Due to Disturbing NOISE

Whether your equipment serves a city of millions, a small town, or just your own plant, ISC can solve the noise problem quickly and inexpensively. Investigate today.

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Builders of HIGH PRESSURE METERING PUMPS Since 1898

div with headquarters at Philadelphia, Clarence H Lender, formerly assistant to the general manager of the apparatus dept, to manager of engineering and acting manager of manufacturing of the affiliated manufacturing companies dept.

General Electric Co, lamp dept, announced that George O Hodgson retired July 31; W S Hemker took over as manager of the Virginia sales district; James P Roger, formerly Virginia manager, replaced Hodgson as Rocky Mountain sales district manager.

McDonnell & Miller, Inc have moved the company's home offices into a new building at 3500 North Spaulding Ave, Chicago 18, Ill.

Marley Co names J C Chase as manager of the recently expanded DriCooper sales dept.

National Supply Co, **Superior Engine Div,** opened a regional office at Kansas City, Mo. under R C Stranbe as regional manager.

E W Nick, formerly president of Northern Equipment Co, has been elected chairman of the board for that company; George L Davis succeeds him as president.

Robert J Wigg became sales-service representative for **Wm Powell Co** in the Pacific northwest with headquarters in Portland, Ore.

George D Keller became manager of the sales engineering dept of **Penn Industrial Instrument Corp.**

Pennsylvania Salt Mfg Co opened a new district sales office in Detroit under Harry N Potts, district sales manager of the heavy chemicals dept.

Ramtite Co announced the appointment of E S Hamilton, Louisville, Ky., as its distributor in that area.

Springfield Boiler Co appointed H L MacElroy manager of the Chicago office and Seltzer & Co, Inc, as Springfield, Mass., representative.

Stadler, Hurter & Co, consulting engineers, Montreal, Canada, have formed an affiliate firm under the name of **Beauchemin & Hurter** with offices in Montreal.

Standard Transformer Co made A & A Supply Co, Albuquerque, N. M., and Abilene, Texas, its representative in their section of the country.

Sperry Products, Inc, selected C T Morgan, Beverly, Mass., as manufacturer's representative in New England.

J R Wing & Co, Windsor, Ontario, became distributor for **Tube Turns, Inc.**

Trumbull Electric Mfg Co named Charles Bangert, Jr, product planning manager, Y T Chaney sales engineering manager of the eastern region, and R C Wilson, sales engineering manager of the central region.

BIDDLE *Instrument News*

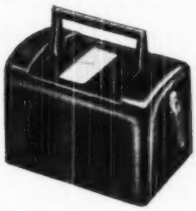
- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

NUMBER 1 OF A SERIES

JAMES G. BIDDLE CO., 1316 ARCH ST., PHILADELPHIA 7, PA.

A *NEW* CONSTANT-VOLTAGE TYPE MEGGER® INSULATION TESTER IN LOW-PRICED RANGE

The trim, modern design of this newcomer to the Megger family of insulation resistance testing instruments is only part of the story. Ohm scale and selector switch are available on all instruments in ranges of 0 to 10 megohms, 100 volts d-c, 0 to 20 megohms, 250 volts d-c, 0 to 50 megohms, 500 volts d-c. The constant-voltage feature is standard with all of these new CVM (Constant Voltage Type Megger) Insulation Testers. These features plus several other mechanical refinements contribute to make this instrument a worthy addition to the popular line of Megger Instruments.



Bulletin 21-80-P, describing this instrument, will be sent on request. Check the coupon below.

GROUND CONNECTIONS ARE A PROTECTION

. . . only if they have low resistance

MEGGER® GROUND TESTING INSTRUMENTS PROVIDE EASY MEANS OF MEASUREMENT

Many seemingly good ground installations offer little protection since high earth resistance renders them ineffective.

There is no assurance that earth resistance will remain constant. It is therefore important that grounds be checked regularly by a reliable, accurate means.

Megger Ground Testing Instruments provide the means in one portable-easy-to-use instrument, for measuring resistance to earth of ground connections, such as rods, pipes, buried plates, and metallic structures. The method is quick, easy and economical—no calculations or adjustments are necessary—anyone can make tests—direct readings are taken in ohms from the scale and pointer.

Fileworthy literature on the subject of Ground Resistance Testing is available without obligation. Write for Bulletin 25J-P which gives instructions and diagrams, or Bulletin 25T2-P, "Grounding Electrical Circuits Effectively" by J. R. Eaton.

THE T-21 MEASURES SPEED SIMPLY BY TOUCH—OR BY MOUNTING ON MACHINE

This new low-priced, miniature FRAHM® Resonant Reed Tachometer is available singly or in kits of three instruments; for hand use or permanent mounting; in ranges from 900 to 13,000 rpm, higher ranges on request.

The T-21 has the advantage of being small and easy to use as a pocket or tool kit instrument and yet easy to read when mounted on a machine. It has no parts to wear out, needs no maintenance, imposes no load on the machine under test, nor can it be damaged by overspeeding.

The simplicity of this resonant reed instrument in no way affects its accuracy—Frahm Tachometers are guaranteed to within 0.5% of their rated frequency of vibration.

For full details on the T-21 Frahm Tachometer, *write for Bulletin 31-35-P* or check coupon below.

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Please mail literature as checked below:

☐ 21-80-P ☐ 25J-P ☐ 25T2-P ☐ 31-35-P
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Job Function _____

Company _____

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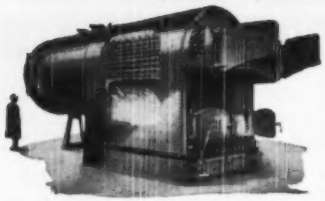

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100, 125 and 150 lbs wp

Has all the characteristics which make firebox boilers ideal for high pressure. Complies fully with ASME and SBI codes.

Outstanding for extra years of dependable service in producing hi-pressure steam economically with Oil, Gas or Coal.

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for 6" scale with pipe diameter markings

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AUTOMATIC CONTROLS
FOR INDUSTRIAL APPLICATIONS
REQUIRING POSITIVE CONTROL
OF PRESSURE, TEMPERATURE,
LIQUID LEVEL ETC.

SIMPLE TO ADJUST FOR THE
SPECIFIED OPERATING RANGE

MERCOID CONTROLS ARE EQUIPPED WITH MERCURY SWITCHES, THEREBY INSURING GREATER SAFETY, BETTER PERFORMANCE AND LONGER CONTROL LIFE

WRITE FOR CATALOG 600-B.

THE MERCOID CORPORATION
4201 BELMONT AVE. CHICAGO 41, ILL.

Dr Charles Wilkie joined the sales engineering staff of **Sika Chemical Corp** with headquarters in Passaic, New Jersey.

Elmer H White, vice-president and general manager, footwear and general products div, **U S Rubber Co,** became adviser to the president, the executive committee and all general managers of sales distribution.

United States Gasket Co picked W S Shambau & Co, Los Angeles, as exclusive representative for the State of California.

Goode Equipment Co, Houston, Texas, are now distributors for a new line of all-purpose pipe protectors developed by the **U S Rubber Co.**

V Lobanoff has been appointed chief engineer for the **United Centrifugal Pumps** div of United Iron **Works,** Oakland, Calif. **Youngstown Sheet and Tube Co** made W H Yuckley, formerly general superintendent of the Campbell Works steel plant, and Dr Karl L Fetters, formerly special metallurgical engineer, assistants to the vice-president in charge of operations.

Yarnall-Waring Co anonunce the following changes: Lytton C Musselman, charge of Los Angeles district with offices at Huntington Park; Power Engineering Co as general sales representative in Salt Lake City; Wallace J Agren as sales engineer, Chicago, to replace F C Harry Vaughan, deceased; R W Westlake, sales engineer, Cleveland; Andrew M Ritter, district manager, Detroit, to replace C H Grosjean, returned to New York and Lyle G Chase, Jr, added to the New York staff.

OBITUARIES

Charles B Carpenter, supervising engineer, Dallas, Texas, petroleum field office of the Bureau of Mines, died June 10 at Dallas at the age of 49.

General Thomas S Hammond, 67, chairman of the board, Whiting Corp, died at his home in Chicago, June 15.

Terrell H Walker, manager of the service and erection dept of Combustion Engineering-Superheater, Inc, died June 9 at the age of 65.

George W Pressell, 62, vice-president of E F Houghton & Co, died suddenly at his summer home, Ocean City, N. J., June 5.

George W Grove, 38, Bureau of Mines, died after a long illness in Pittsburgh, June 5.

Charles S Hammond, assistant to the president, George Power Co, died May 19 on a business trip.

E J Dailey, 62, manager power apparatus sales for Graybar Electric Co, died of a heart attack, June 21, at his home in Pelham Manor, N. Y.

Frank F Law, vice-president, Wyeth, Inc, died at the age of 56, June 5, at the University of Pennsylvania Hospital, Philadelphia.

Changing Address ?

- If you are planning to move, please be sure to let our Circulation Department know about it — and as far in advance as possible.
- It takes time to correct the stencil addressing plate and to make the correction on all our records. So your prompt notification will help us make sure you do not miss copies of POWER.
- Be sure to give us your OLD address as well as your NEW address. We need them *both* to make the correction.
- Mail in the coupon if you plan to move. And please fill it in as completely as possible.

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4 Plants Are Behind Them !

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Los Angeles 23—520 Anderson St. • Houston 2—1213 Capitol Ave.
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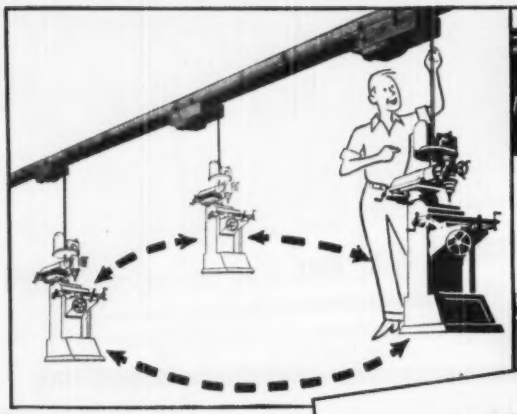

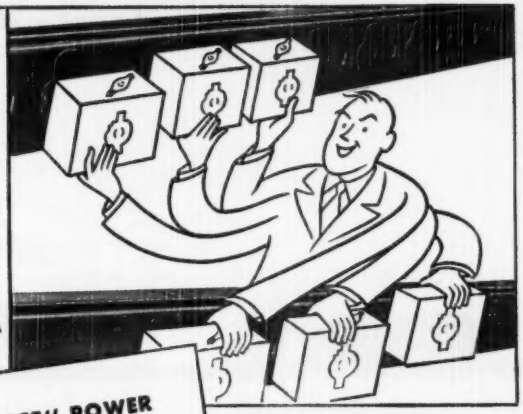

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Always Flexible

Like a continuous panelboard

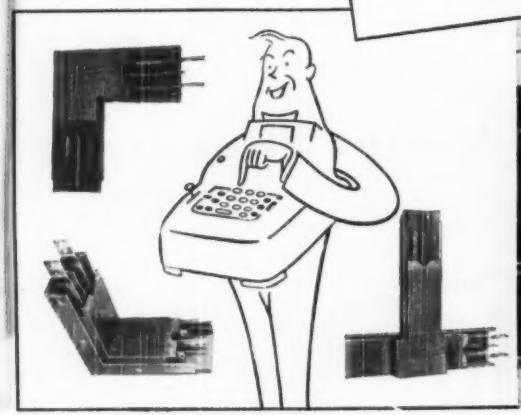
How much time, trouble and money *could* you save if your electric power came off a panelboard running the *entire length* of your plant?

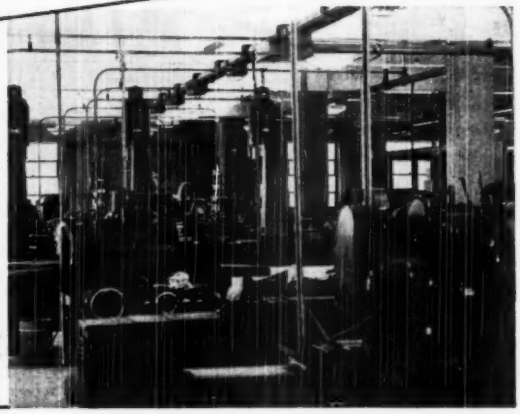
That, in effect, is FVK FLEX-A-POWER* — pre-fabricated busway for 225-1000 amps, 600 volt secondary feeder systems. It's as convenient as curb service — wherever you put a machine, *there's* an outlet.

Relocate loads without rewiring

Every 10-ft section of FVK busway has 15 outlets. You can plug in right at the load . . . rearrange or add loads without rewiring or bothering with extension wires.

Even in cases of major alterations, you can quickly dismantle FLEX-A-POWER, move and reinstall it with practically 100% reuse of materials.





Cheaper to install, too

Standardized parts — straight lengths, elbows, offsets, etc. — delivered to job ready for installation . . . quickly, easily coupled and suspended to conform to any plant layout . . . keep installation time and costs *low!*

Maintenance cost is cut to the bone. Housings resist entrance of dirt and moisture. Materials are made to last.

Remington Rand's Laboratory of Advanced Research at South Norwalk, Conn., saves much time and money by keeping its electrical system flexible. Machinery is quickly relocated without lengthy shutdown. Write for new booklet TEB-4,

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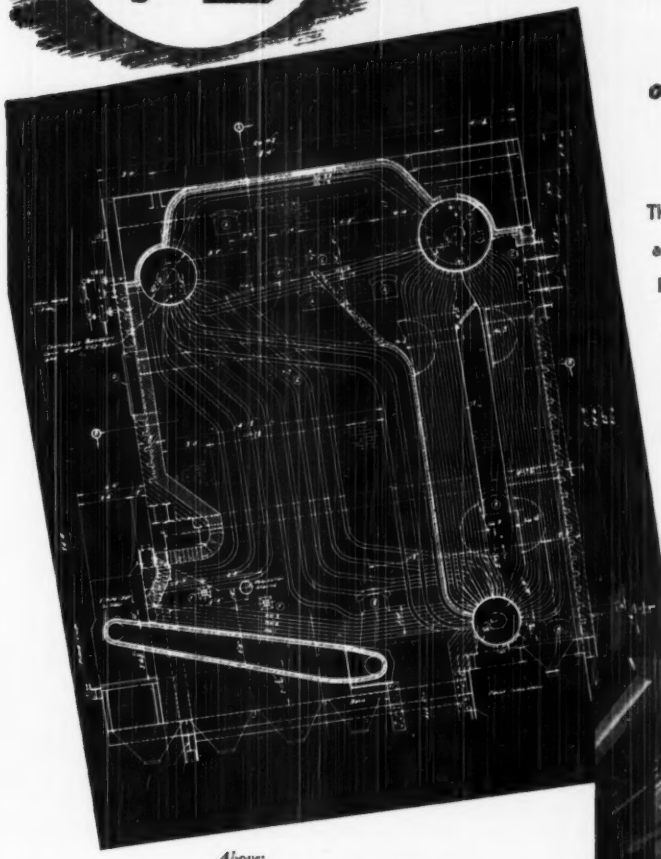
TRUMBULL'S TRAINLOAD OF NEW PRODUCTS

CLASS **VL**

Vogt Steam Generating Units

for POWER *or* PROCESSING LOADS, *and* HEATING

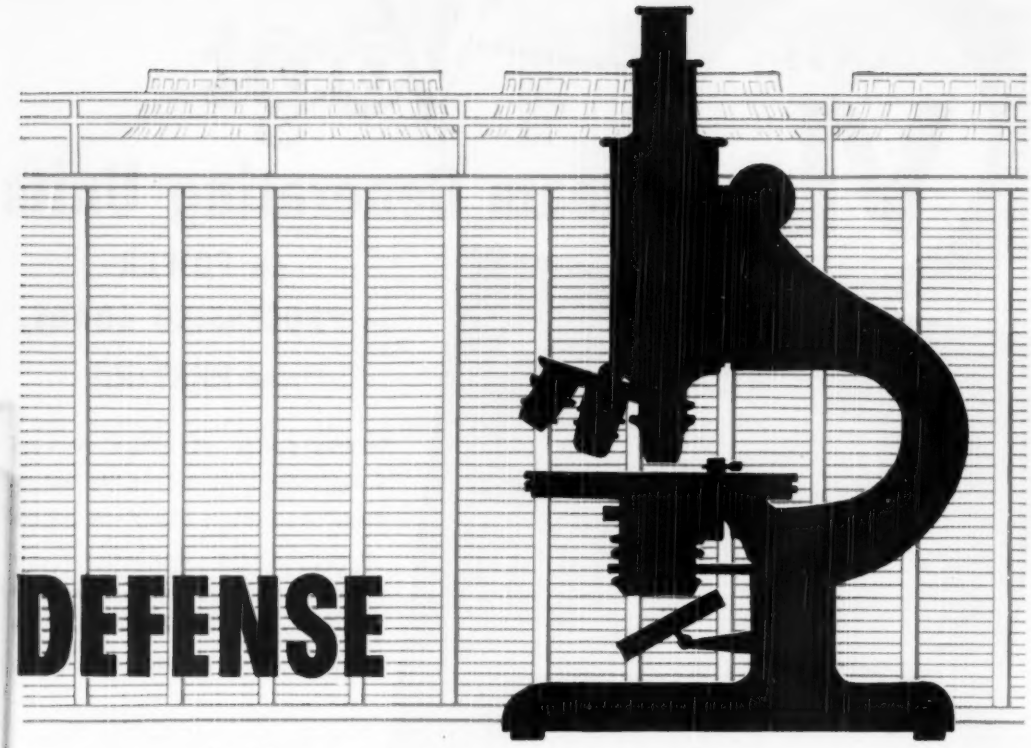


The design provides large furnace volume and a high ratio of radiant heating surface. Proper combustion is assured with any fuel or method of firing. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Vogt Class VL Steam generating units are giving satisfactory service in Hotels, Sugar Refineries, Steel Mills, Furniture Factories, Distilleries, Oil Refineries, and related industries. A bulletin showing typical installations will be sent upon request.

Above:
This 90,000 lbs. steam per hour unit, designed for 475 lbs. pressure, serves the Mansfield Tire & Rubber Co., Mansfield, Ohio.

Right:
Two 515 H.P. units installed in Brown-Forman Distillers Corporation, Louisville, Ky. Plant.

HENRY VOGT MACHINE CO. • 1000 W. Ormsby St., Louisville 10, Ky.
Branch Offices: New York, Philadelphia, Cleveland, Chicago, St. Louis, Dallas



DEFENSE against bacterial warfare

Every water usage point in an industrial plant presents its own particular group of problems, and at certain points—particularly cooling systems—one of the major problems is created by bacteria.

"Aerobacter aerogenes" may produce slime, impairing heat transfer in condensers and coolers. In well water systems, "Desulfovibrio desulfuricans" may cause the formation of hydrogen sulfide, thus greatly increasing corrosion. "Gallionella," an iron-fixing organism, may plug up pipe lines, reducing the capacity of equipment or putting it out of service.

Bacteriologists of Hall Laboratories have had long experience in water problems arising from bacteria and other organisms. With their cooperation, Hall engineers develop and apply the procedures which best meet each specific situation.

Bacteria and other micro-biological growths may not cause you concern, but if you have any problem in the industrial use of water you will be interested in the new Hall bulletin, "Your Most Important Raw Material." May we send you a copy?

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

HALL *plant-wide* WATER SERVICE

BOILER WATER CONDITIONING

PROCUREMENT, TREATMENT, USAGE AND DISPOSAL OF INDUSTRIAL WATER

No place for Rip Van Winkles

TWENTY years bring changes--changes far greater in our fast-moving world than ever happened in Rip Van Winkle's day.

Americans are awakening to unpalatable facts--that the enterprise system which built our nation and made it strong is being subtly undermined; that advocates of backdoor socialism and communism thrive in our midst; most dangerous of all, that our young people are misinformed on economics.

For example, a recent survey of high school seniors reveals that they estimated that it takes only an $81 investment to provide a job. Actually, as shown by the 1947 census, the 2256 establishments of the iron and steel industry invested $545 per worker that year alone in *new* plant and equipment. Total investment to provide one job runs well above $10,000.

These youth had a similarly distorted picture of profits. They believe shareholders receive 24% of the sales dollar whereas they receive an average of less than 3%.

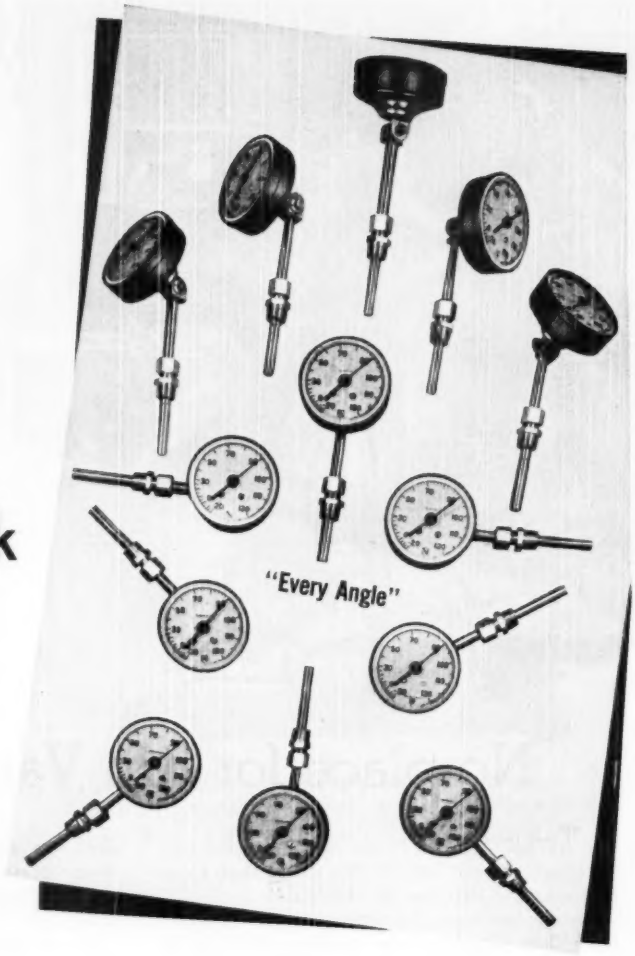
Misinformed minds are a ready field for imported false philosophies. And it is up to you, a business leader in your community, to take responsibility toward correcting these misunderstandings. The American businessman must not permit himself to be lost in Rip Van Winkle befuddlement.

THE YOUNGSTOWN SHEET & TUBE CO. 1900 YOUNGSTOWN 1950 50 YEARS OF SERVICE

The Youngstown Sheet and Tube Company
General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York
MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

ELECTROLYTIC TIN PLATE - COKE TIN PLATE - WIRE - COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - CONDUIT - RODS - SHEETS - PLATES - BARS - RAILROAD TRACK SPIKES.

Just TWIST its neck



Install the American Every Angle Thermometer in any difficult place, on an irregularly shaped tank, boiler or other equipment.

Then turn its face to the exact spot where you can see it best. If the light changes turn it again —as many times as you want— for it will survive many thousand turns without impairing its enduring accuracy.

It is adaptable to all types and shapes of process equipment for the neck can be moved and turned to a full 180 degrees on two axes.

This useful feature does not affect the accuracy in any way for the fine quality of American Thermometers has kept them leaders for a hundred years.

1850—1950

A Century of Service to American Industry

American Glass, Dial and Recording Thermometers are sold by leading distributors everywhere. Write to them or us for information.

MAXWELL MANNING & MOORE INC. TRADE MARK

AMERICAN

Industrial Instruments

A Product of

MANNING, MAXWELL & MOORE, INC.

STRATFORD, CONNECTICUT

Makers of 'American' Industrial and 'Microsen' Electrical Instruments, 'Hancock' Valves, 'Ashcroft' Gauges, 'Consolidated' Safety and Relief Valves. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.

Long condenser life starts right here!

CHASE ANTIMONIAL ADMIRALTY

(a patented alloy)

Thousands of installations since 1935 *prove* that long service life starts with Chase Antimonial Admiralty. Here's why:

Admiralty with an antimonial content of less than .007% (the minimum set forth in Chase Patent No. 2,061,921) cannot be depended on to guard against dezincification under all conditions. For a wide range of applications, .015% is the smallest safe amount. Chase makes *sure* you get this minimum despite normal commerical variations —by using a nominal content of .035%.

That's the time-tested Antimonial Admiralty—patented by Chase, made only by Chase. Get the facts today.

Special stocks of ANTIMONIAL ADMIRALTY Condenser Tubes in Chase Warehouses: NEW YORK, BALTIMORE, NEW ORLEANS LOS ANGELES, SAN FRANCISCO

also carried by—
Vinson Supply Co., Tulsa
Standard Brass & Mfg. Co., Houston

Chase

the Nation's Headquarters for
BRASS & COPPER

WATERBURY 20 CONNECTICUT — SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

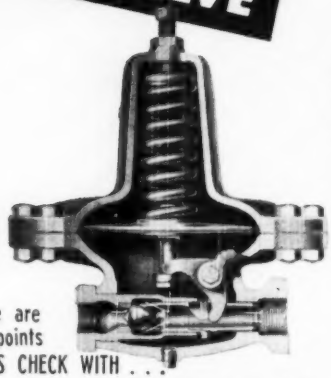
ALBANY ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DALLAS DENVER DETROIT HOUSTON INDIANAPOLIS KANSAS CITY MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER ST. LOUIS SAN FRANCISCO SEATTLE WATERBURY

WOULDN'T YOU LIKE to say GOODBYE

TO THESE TROUBLEMAKERS

YOU CAN DO IT WHEN YOU INSTALL THE

CASH STANDARD Streamlined PRESSURE REDUCING VALVE TYPE 1000



A few Typical USER STATEMENTS

"In our business where we must CONTROL OUR STEAM PRESSURE and the curing temperature TO THE FINEST DEGREE, we have found that the CASH STANDARD Type '1000' valves HAVE MET ALL DEMANDS, giving us the type of cure that is so necessary to an acceptable molded product."
—from a Production Manager

"We have confidence in the performance of the CASH STANDARD '1000' and USE IT EXCLUSIVELY with oil firing control assemblies."
—from an Engineering Corporation

"The two CASH STANDARD Type '1000' pressure reducing valves that we use have, since their installation, GIVEN PERFECT OPERATION WITH NO MAINTENANCE."
—from a Laboratory

"The CASH STANDARD Streamlined Valves we have are DOING A SPLENDID JOB. WE CAN NOT RECALL ANY MAINTENANCE ON SAME AS YET. Some have been IN SERVICE 4 OR 5 YEARS."
—from an Axle Manufacturer

"We have two of these valves in operation on air pressures of 130 lb. and HAVE FOUND THEM TO OPERATE SATISFACTORILY on this pressure down to 60 lb., which are the only pressures we use."
—from a Manufacturer

These are the points USERS CHECK WITH . . .

1. **Maximum capacity when needed most.**
2. **Accurate pressure control under toughest working conditions.**
3. **Trouble-free service.**
4. **Smooth operation.**
5. **Tight closure.**
6. **Speedier production results.**
7. **Elimination of failures.**
8. **Cost-saving operation.**
9. **No spoilage.**
10. **Practically zero in maintenance.**

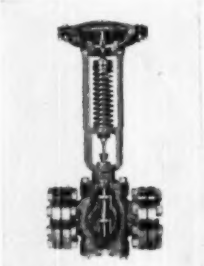
Send FOR BULLETIN 962

CASH STANDARD CONTROLS.. VALVES

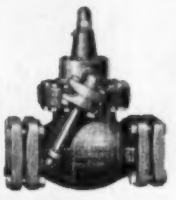
A. W. CASH COMPANY
DECATUR, ILLINOIS

BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES
Send for them

Bulletin 963 features the CASH STANDARD Type 100 Series of Super-Sensitive Controllers — various types for automatically operating valves, dampers, rheostats, stokers, pulverizers, fans, and other apparatus. 16 pages filled with descriptions and applications.

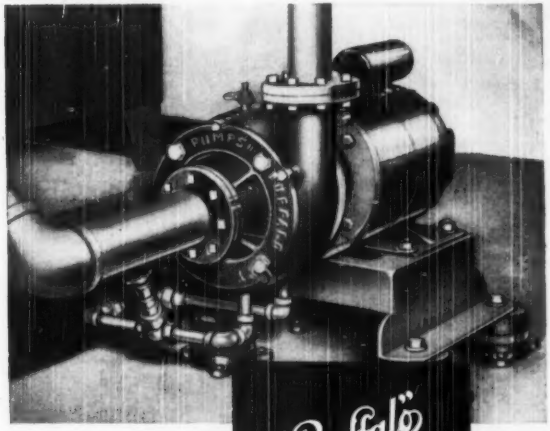


Bulletin 968 features the CASH STANDARD Type 34 Pressure Reducing Valve — direct operated — direct acting for handling steam, hot water, cold water, air, oil, brine—and most liquids and gases except some injurious chemicals. Illustrates and describes the different styles available and tells about their applications. Three pages of capacity charts.



Bulletin 956 features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

"Buffalo" Class "RR" Pump for Boiler Feed and Other Clear Water Service.



"Buffalo" No. 1½ CCS Close-Coupled Pump Circulating Water for Air Conditioning.

"Buffalo"
CENTRIFUGAL
PUMPS FOR
EVERY SERVICE

ECONOMY

THE INEVITABLE RESULT OF TROUBLE-FREE "Buffalo" PUMP PERFORMANCE

● Ask anyone who has used pumps a good long while—he'll say the ECONOMICAL pump is the one you can practically ignore! It not only saves on repair bills, but on expensive time-outs where plant functions depend on pumping.

If you want this major economy, specify "Buffalo" for your next pumping job. "Buffalo" construction—impellers, bearing stands, shafts, casings and stuffing boxes—makes no compromise with quality. Add to this the economy of high-efficiency performance—and the inevitable result of owning a "Buffalo" Pump is economy that adds up through the years.

Call in your "Buffalo" engineering representative, or write us for complete information.

BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, N. Y.

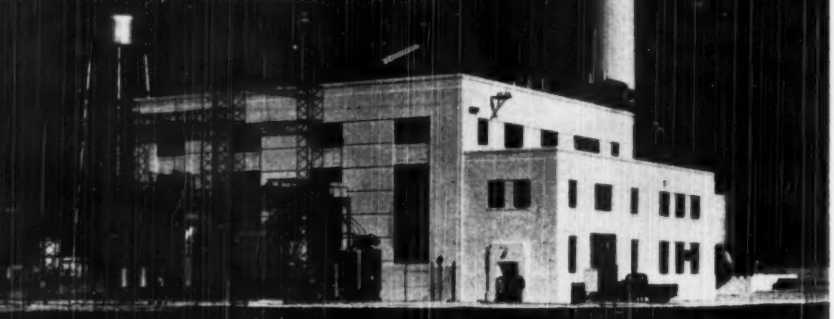
Canada Pumps, Ltd., Kitchener, Ont.

Branch Offices in all Principal Cities

RIC·WIL GIVES YOU

3-WAY EFFICIENCY

...IN SYSTEM DESIGN
...IN FAST INSTALLATION
...IN PEAK PERFORMANCE



When you have an insulated piping problem, remember that only the best will give you ALL the advantages necessary to full-efficiency performance of your system. That means Ric-wiL Prefabricated Insulated Piping.

Ric-wiL provides all the factors that insure (1) top-efficiency system design; (2) fast, economical installation; (3) the right protection and insulation for the job.

Ric-wiL maintains a competent Piping Engineering staff for assistance to architects, engineers, and contractors in the planning of insulated piping systems and preparation of accurate, time-saving installation drawings.

Ric-wiL prefabricated straight sections and complete line of accessories provide fast, economical installation by eliminating the many inefficiencies of field fabrication of insulating and protective materials.

Peak operating performance is constantly insured in Ric-wiL systems by the fine material and workmanship used in producing Ric-wiL products. From the raw material stage through every phase of fabrication, skilled craftsmen build into Ric-wiL piping every known component for long, efficient operating life.

And remember this . . . only Ric-wiL provides *all* the features necessary to maximum protection, insulation, and high efficiency operation of underground or overhead insulated piping systems.

The Ric-wiL representative nearest you will be glad to give you full information on Ric-wiL as applied to your problem. If you prefer, write to Dept. 5-OA at Cleveland, Ohio, for full technical information.

40th YEAR DEPENDABLE INSULATED PIPING SYSTEMS 1910-1950

RIC·WIL

INSULATED PIPING SYSTEMS

THE RIC-WIL COMPANY · CLEVELAND, O.

OVERHEAD UNDERGROUND

FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS

GOOD QUALITY STEAM

even at concentrations above 15,000 parts per million!

You may find it hard to believe that good quality steam can be produced with boiler concentrations in excess of 15,000 parts per million. But look at this analysis of samples from a Southwestern refinery power plant.

HERE'S PROOF!

THE BIRD-ARCHER COMPANY
NEW YORK 17, N. Y.

PHILADELPHIA 40, PA.
LABORATORY AND PLANT
4027 NORTH AMERICAN STREET

GENERAL OFFICES
400 MADISON AVENUE

CHICAGO 11, ILL.
WRIGLEY BUILDING

Date: April 27, 1950

CHEMICAL ANALYSIS

Results expressed in parts per million

SAMPLE MARKED	Boiler Make-Up (Raw)	Condensate	Boiler Feed	Boiler #5	Boiler #8
ANALYSIS NUMBER 500410					
Total Dissolved Solids	1002	6	612	15980	13992
Suspended Solids	Trace	0	8	1052	332
Carbonate Hardness ($CaCO_3$)					
Non Carbonate Hardness ($CaCO_3$)					
Total Hardness ($CaCO_3$)	36	0	20	0	0
Calcium ($CaCO_3$)	24				
Magnesium ($CaCO_3$)	12				
Sodium (Na)					
Silica (SiO_2)	13		7	88	88
"P" Alkalinity ($CaCO_3$)	0	0	8	1520	1410
"M" Alkalinity ($CaCO_3$)	168	4	112	2160	1910
"OH" Alkalinity ($CaCO_3$)			0	1030	1020
Chlorides (Cl)	420	0	256	5900	5340
Sulfate (SO_4)	27	0	12	234	212
Phosphate (PO_4)		0	0	60	55
Nitrate (NO_3)					

Caustic embrittlement observations have been made at this plant for more than ten years with continual negative findings.

HOW? **with CONCENTROL**

Bird-Archer's new Concentrol was specially developed to eliminate foaming and boiler water carryover due to high alkalinity, dissolved solids, suspended solids or any combination of them.

Concentrol works by effecting a rapid change in surface tension of steam bubbles which permits coalescence of small steam bubbles into bubbles of larger size. This results in the formation of unstable bubble films which break readily upon reaching the steam disengaging surface of the boiler water, thus eliminating foam build-up and subsequent boiler water carryover.

Concentrol is available in several different formulations, some of which contain selected tannins, which condition boiler water sludge and suspended matter, maintaining them in a highly fluid, non-adherent form. Concentrol may be safely fed through feedlines and when fed continuously will help inhibit feedline deposits.

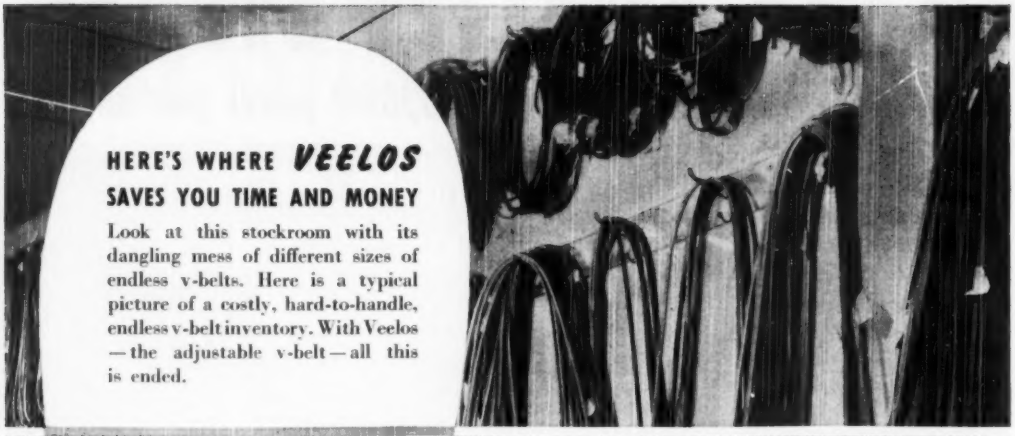
For full details on economical, efficient Concentrol, send for Data Sheet. For recommendations on your specific problem, consult your nearest Bird-Archer representative. Or, write direct to Bird-Archer outlining the details of your boiler operation.

BIRD-ARCHER
WATER TREATMENT

THE BIRD-ARCHER COMPANY, 400 MADISON AVE., NEW YORK 17, N. Y.
PHILADELPHIA • CHICAGO
IN CANADA: The Bird-Archer Co., Limited, 503 McGill Building, Montreal, Canada
IN MEXICO: Calderas y Accesorios, S. A., Amsterdam 291, Mexico, D. F.

LABORATORIES · ENGINEERS · CHEMISTS

BA-150



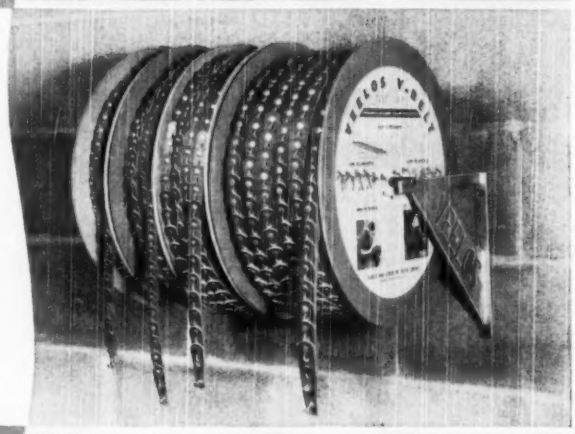
HERE'S WHERE *VEELOS* SAVES YOU TIME AND MONEY

Look at this stockroom with its dangling mess of different sizes of endless v-belts. Here is a typical picture of a costly, hard-to-handle, endless v-belt inventory. With Veelos — the adjustable v-belt — all this is ended.

WITH *VEELOS*, ANY BELT SIZE IS ALWAYS ON HAND

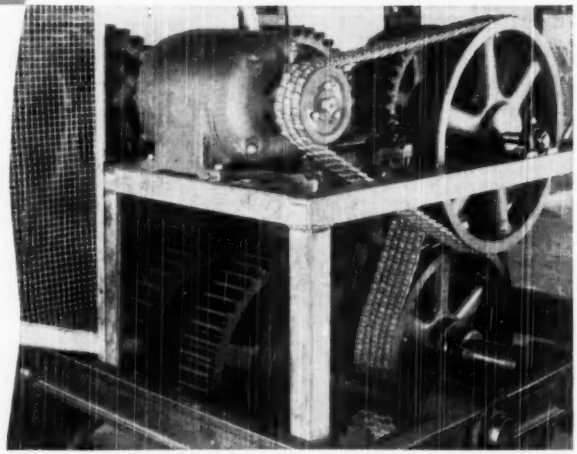
These four reels of Veelos alone can *replace* up to 316 sizes of endless v-belts in the O, A, B and C widths. No more stockroom troubles, no more replacement headaches because Veelos is *always* ready—in the widths you require.

If you are interested in reducing your v-belt costs and increasing your production efficiency, you should have a Veelos Data Book. For free copy of this illustrated book complete with engineering information write*



VEELOS ASSURES MAXIMUM MACHINE PRODUCTION

Veelos is easy to install *without* dismantling outboard bearings. Veelos runs true for vibrationless, full power delivery. Because Veelos is adjustable, uniform belt tension is easily maintained.



VEELOS
THE LINK
V-BELT

ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

Made in all widths in three types: regular, oil-proof, static conducting. Also double V in A and B. Packaged on reels in 100-foot lengths. Sales engineers in principal cities; over 350 distributors throughout the country. Veelos is known as VEELINK outside the United States.

***MANHEIM MANUFACTURING & BELTING COMPANY, MANHEIM, PA.**

Zallea Expansion Joint News

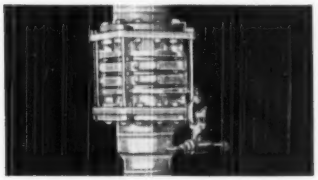
PUBLISHED BY ZALLEA BROTHERS—WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

Expansion Joint of the Month

Why Zallea Joints Last Longer

ANOTHER ZALLEA REPEAT

When West Penn Power Company added No. 7 Unit to its Springdale, Pa. Station in 1945, Zallea Stainless Steel Expansion Joints were installed to provide for expansion of the piping. Three years later, West Penn *again* selected Zallea Joints for use in its new Mitchell Station at Courtney, Pa. And, a second unit at Mitchell, recently constructed, is *also* equipped with Zallea Stainless Steel Expansion Joints. Here, as in hundreds of cases, satisfied repeat customers continue to specify Zallea when they want



the utmost in economy, dependability and long service life. *There's no packing to deteriorate . . . no maintenance required.* There's a Zallea Expansion Joint for almost every requirement. Available in diameters from 3″ to 72″ for temperatures from sub-zero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs and up to 2000 psi in special designs.

. . . a complete, practical catalog on all Zallea Expansion Joints. A text book and a valuable reference source. Send for your *free* copy *today!*

ZALLEA BROTHERS, 814 Locust Street, Wilmington 99, Delaware

Longer Service Life Assured Through Controlled Manufacture

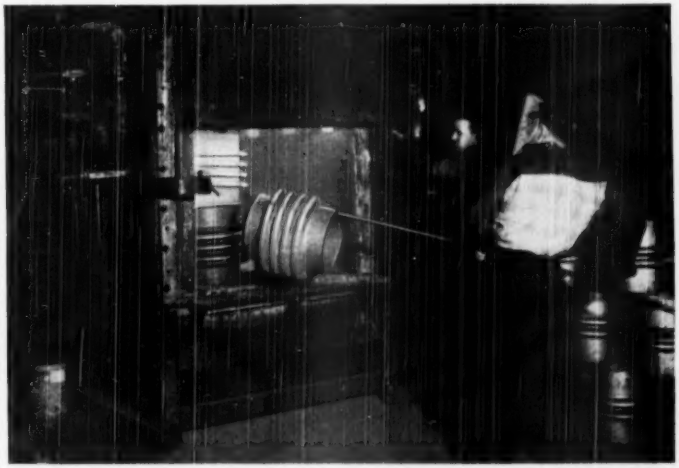
After the expansion joint cylinder has been formed, welded, and sized to exact dimensions (the length often being more than double that of the finished product), it is placed in one of several powerful hydraulic forming machines of our own design, which bulge the corrugations against accurately machined steel dies under extreme internal pressure at the same time the ends are forced toward each other. By this process, the additional metal required in the corrugations is obtained.

Controlled Annealing

After the final bulging operation, the expansion joints are given a full anneal to remove all stresses left by the forming operation. Proper heat treatment is essential to secure maximum potential expansion joint life. The corrugated element must be slowly and uniformly heated to a predetermined temperature, held at that temperature for a definite time, then cooled at a definite rate.

Standard Method Unsatisfactory

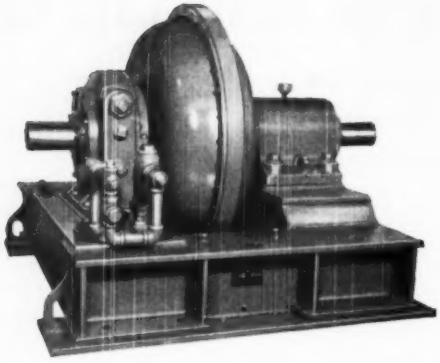
This cannot be accomplished successfully by heating the expansion joint with a torch until it shows an indefinite color. Yet, such is the method most often used in the manufacture of corrugated expansion joints. All Zallea Stainless Steel Expansion Joints are properly heat treated in one of several gas-fired furnaces of the type illustrated below. These furnaces are equipped with the most modern temperature controls, capable of maintaining a constant temperature at any point up to 2000° F., within 25 degrees. Recorders provide a permanent record of each heat. The control exercised in *every* phase of manufacturing Zallea Stainless Steel Expansion Joints assures dependable, long service life. When you want to be sure . . . always specify Zallea . . . you'll find it pays!



Removing stainless steel expansion joint elements from furnace after annealing at 1950° F.

(Advertisement)

Improve over-all power plant efficiency with...
GÝROL FLUID DRIVES FOR MECHANICAL DRAFT FANS



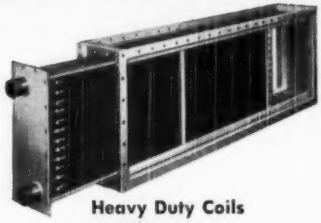
Type VS Gýrol Fluid Drive for Mechanical Draft Fans

The smooth flow of power and adjustable speed features of Gýrol Fluid Drives for Mechanical Draft Fans offer substantial power savings, quieter operation and, where erosion occurs, increase the life of wheel and housing.

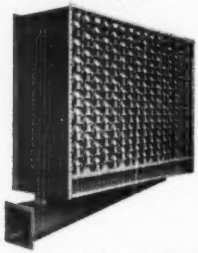
For complete information on Gýrol Fluid Drives for Mechanical Draft Fans, write for our Bulletin 7019.

And if you'd like data on American Blower Mechanical Draft Fans, Fly Ash Precipitators, Heavy Duty Coils and Gýrol Fluid Drive for boiler feed pumps—write, stating your requirements, or phone the nearest American Blower Branch Office.

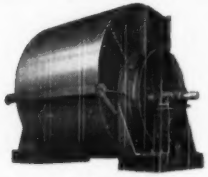
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION



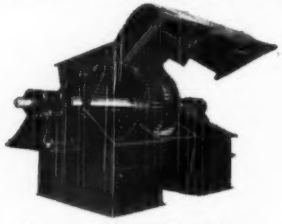
Heavy Duty Coils



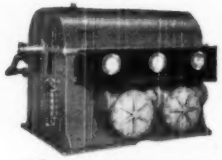
Type ST Fly Ash Precipitators



American HS Forced Draft Fans



Sirocco Induced Draft Fans



Gýrol Fluid Drives for Boiler Feed Pumps

YOUR BEST BUY AMERICAN BLOWER POWER PLANT EQUIPMENT

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

TO DO A BETTER PIPING JOB...

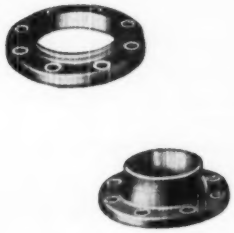
USE GLOBE PRECISION PROCESS SEAMLESS WELDING FITTINGS

Your preference for Globe Welding Fittings is supported by a source of supply with exceptional qualifications. Specialized metallurgical experience and facilities gained in years of steel tubing manufacture enable Globe to produce welding fittings by a precision process that yields a superior product.

Send for the Globe Welding Fittings Catalog No. 501.

GLOBE STEEL TUBES CO., Milwaukee 15, Wisconsin

Chicago — Cleveland — Detroit — New York — Philadelphia — St. Louis — Tulsa — Houston — Denver — San Francisco — Glendale, Calif.



Producers of Globe Seamless Stainless Steel Tubes —Gloweld Welded Stainless Steel Tubes—Carbon — Alloy — Seamless Steel Tubes — Globeiron Seamless High Purity Ingot Iron Tubes and Pipe.

SIZE RANGE OF GLOBE SEAMLESS WELDING FITTINGS

Description of Fitting	Standard Weight (Schedule 40)	Extra Strong (Schedule 80)	(Schedule 160)	Double Extra Strong
Elbows 45° Long Radius	½ in. to 24 in.	⅜ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Long Radius	½ in. to 24 in.	⅜ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Returns 180° Long Radius	½ in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	3 in. to 8 in.
Returns 180° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Reducers (Concentric and Eccentric)	1 x ½ in. to 24 x 20 in.	1 x ½ in. to 24 x 20 in.	1 x ½ in. to 12 x 10 in.	1 x ½ in. to 12 x 10 in.
Tees Straight	¼ in. to 24 in.	¾ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Tees Reducing Outlet	½ in. to 24 in.	¾ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Stub Ends Lap Joint	1 in. to 24 in.	1 in. to 24 in.	- - -	- - -
Caps	1 in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.

Flanges available 1 inch to 24 inches in all weights

All These Were Once
DUST COLLECTION PROBLEMS, TOO

48 Carbon Black Plants

203 Metallurgical Installations

205 Acid Plants

40 Paper Mills

270 Detarring Installations

216 Power Stations

73 Steel Plants

99 Oil Refineries and Miscellaneous Installations

Your electrical precipitator installation will be individually engineered...and based on the Research Corporation's *experience* graphically shown by that towering pile of thousands of blue prints.

This knowledge is a valuable asset that will help Research engineers to "tailor-make" your Cottrell installation. For example, they can more quickly determine the right answers to such variables as the size, shape and type of both discharge and collecting electrodes, their relative spacing, flue arrangements and many other factors. At Research you can count on *profitable solutions to individual problems.*

In hundreds of power plants today, Research Corporation Cottrells are collecting 90% to over 99% of fly ash from pulverized fuel boilers. Write for your free copy of an informative booklet giving valuable data on these installations. RC-116

Typical One Day Collections:

250 TONS OF FLY ASH • 6 TONS OF SODA SALTS AT A PAPER MILL • 25 TONS OF SODIUM SULPHATE AT A KRAFT MILL • 6 TONS OF BLAST FURNACE DUST

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
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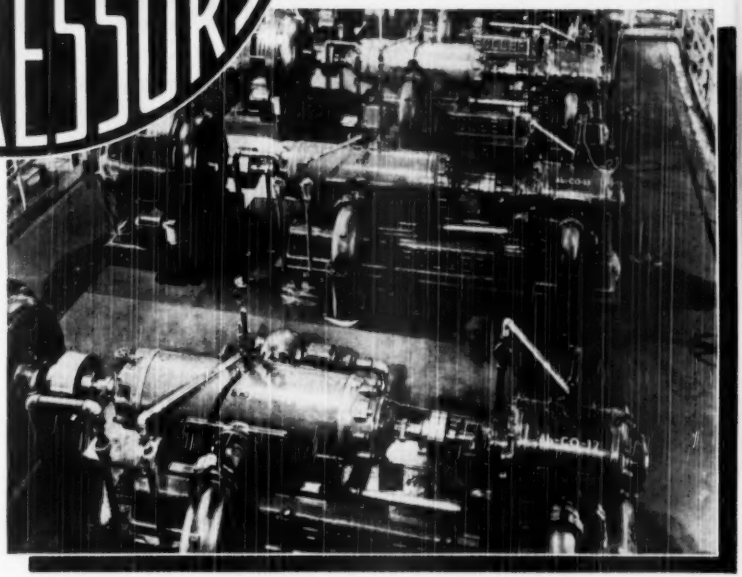
FULLER ROTARY COMPRESSORS

For

100-125-LB. PRESSURE

3300 C.F.M

ACTUAL FREE-AIR DELIVERY



Four Fuller Rotary Two-stage Compressor installation.

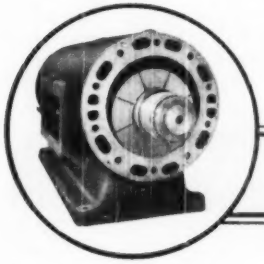
Capacity each, 1665 c.f.m., 100-lb. pressure.

Maybe you are one of those who has the impression that Fuller Rotary Compressors are built only for low-pressure service. Fuller Rotary Two-stage Compressors have been built, and installed, for many years for pressures up to 100 and 125-lb. gage. These high-pressure machines are just as dependable as the single-stage machines for the lower range of pressures.

For example, one of the largest manufacturers in this country has purchased and installed, during the past ten years, 43 Fuller Rotaries, of which number, 37 are of the two-stage high-pressure design; another company installed 12, of which seven are for high pressure; another installed six, all for high-pressure operation.

We are continually selling and manufacturing these high-pressure machines, and would welcome an opportunity to discuss Fuller Rotary Compressors with you.

No. 3 of a series



FULLER COMPANY, CATASAUQUA, PA.

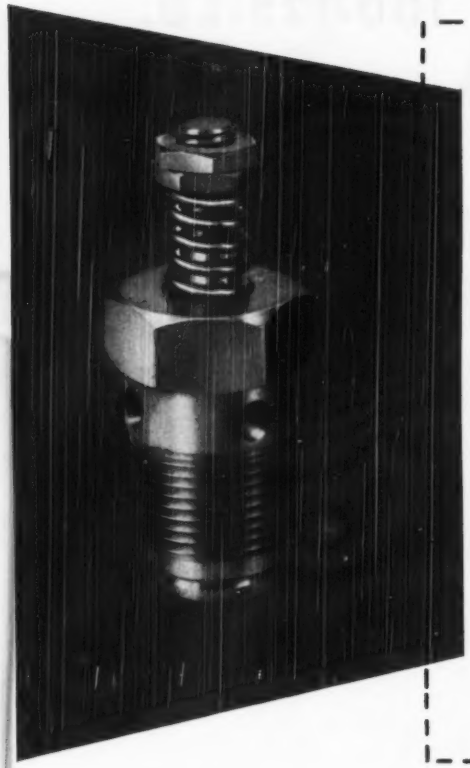
CHICAGO 3 - 120 SO. LASALLE ST.

SAN FRANCISCO 4 - 420 CHANCERY BLDG.

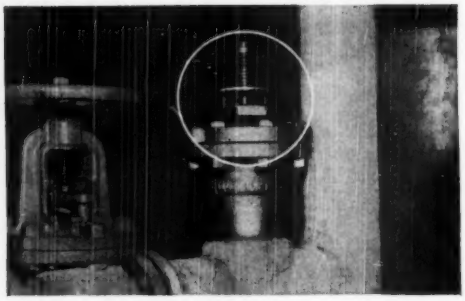
A LIFETIME OF NEW MACHINE EFFICIENCY

C-193

Protect Your Closed Process Vessels For As Little As $5.00



With The HONEYWELL VACUUM BREAKER



Vacuum breaker on steam line feeding a stripping column. If steam demand from other units is enough to create a vacuum, breaker opens, preventing collapse of stripper.

SOMETIMES the evacuation of fluid from closed vessels is so rapid that collapse is caused by the pressure differential between atmosphere and inside vacuum. Inserted at the proper place in the system, the Honeywell Vacuum Breaker will prevent such costly trouble . . . by permitting atmospheric air to enter before damage is done. That's mighty economical insurance at a price of less than $5.00 for the 1" size.

The Honeywell Vacuum Breaker is rugged and dependable. It will not clog, requires a minimum of maintenance and is easily adjusted to the desired vacuum setting. It is exceptionally compact . . . the 3" size is but 6½" high.

Standard sizes, from ½ to 3 inches, are stocked . . . they are spring loaded, are made of bronze and are furnished with screwed connections. *Larger sizes*, up to 8 inches, may be ordered . . . they are weight loaded, are made of cast iron and are furnished with flanged connections.

Call in your local Honeywell engineer for a discussion of further details . . . and ask him about such other Honeywell process specialties as Transfer Valves, Hi-Lift Hand Valves and the Honeywell Space-Saving Bypass. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 1900 Windrim Avenue, Phila. 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

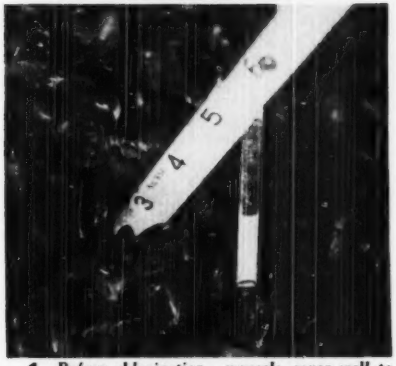
MINNEAPOLIS **Honeywell**

VALVE PRODUCTS

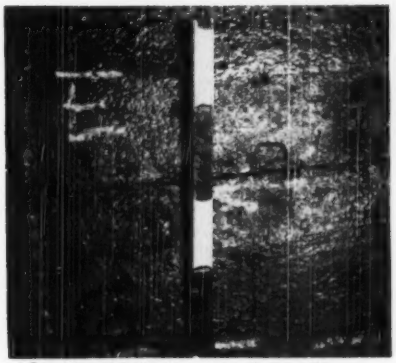
CHLORINATION BY WALLACE & TIERNAN

CONTROLS MARINE FOULING AT GENERATING STATION

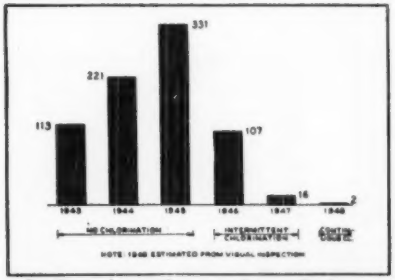
LOOK AT THESE RESULTS



1. Before chlorination — mussels cover wall to depth of 3".



2. After chlorination — note bare wall.



3. Tons of mussels removed annually from intake tunnel of generating station.

It all began when a New England generating station sent down a diver for a routine inspection of the large, concrete, circulating-water, intake tunnel located approximately 13 feet below the harbor's surface. The diver discovered this intake was lined with unusually heavy growths of common mussel (Mytilus), sea moss (Tubularia), and sea anemone (Metridia).

These were expensive visitors. First, mussel accumulation created poor vacuum as the mussels lodged in condenser tubes and aggravated slime and silt formation. Then, as the mass increased in quantity, it became necessary to clean the intake tunnel every year to remove up to a maximum of 331 tons of mussels — a time consuming process that cost thousands of dollars in labor and equipment outage.

To combat these conditions a long and thorough study was made of marine fouling. As a result it was decided to use intermittent chlorination applied by Wallace & Tiernan Chlorinators. First to fall under this attack were the sea moss and the sea anemone. The tougher mussels however, still remained as numerous as ever.

In an all out effort to get rid of these trouble makers, continuous chlorination at heavier residuals was started. This treatment turned the trick and the mussels were reduced to such a low level that yearly cleaning has not been required.

These results saved the New England company thousands of dollars annually by eliminating intake tunnel cleaning, reducing condenser outages, and producing a higher vacuum with a resultant saving in fuel.

Perhaps your problem is one of slime or fouling due to some other marine organism. In any event, if biological fouling is costing you money through lowered cooling water efficiency it's a safe bet that chlorination can help.

See your nearest Wallace & Tiernan Representative now for all the details.

CD-34

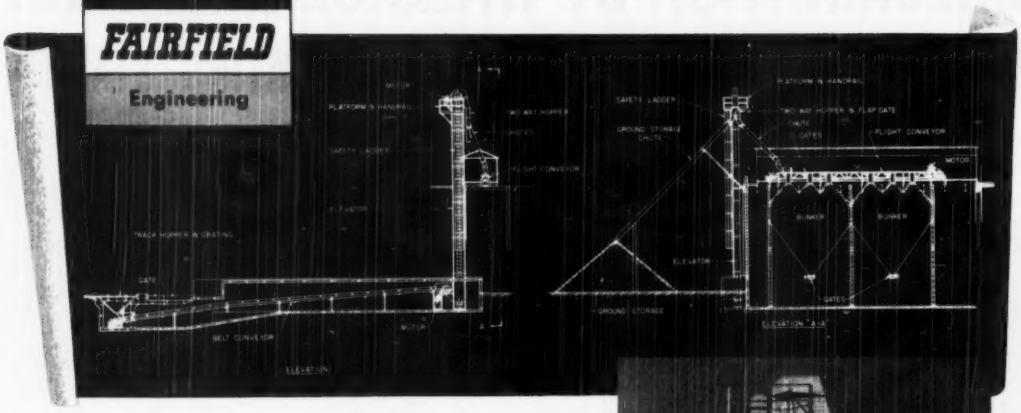
WALLACE & TIERNAN
PRODUCTS, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
Belleville 9, New Jersey • Represented in Principal Cities

Progressive

FAIRFIELD

Engineering

SERVING THE NATION'S POWER PLANTS



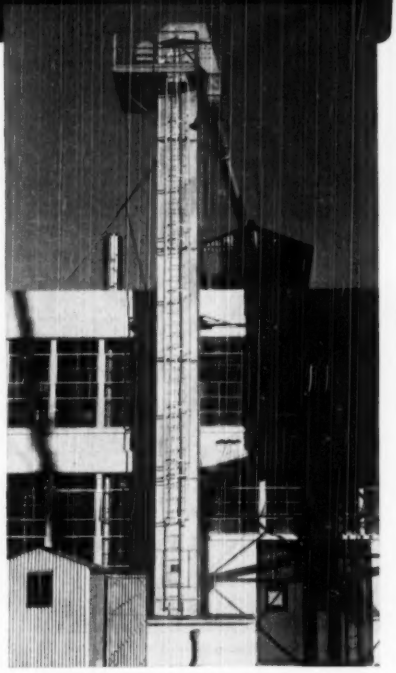
From Maine to California

And all the stops between, there's a Fairfield Coal and Ash Handling System at work in the vicinity . . . providing efficient, low cost handling. One of the many reasons Fairfield equipment enjoys this wide-spread usage and its enviable reputation in the Power field stems from the fact that at Fairfield, 35 years of know-how engineering is applied to every job—large or small.

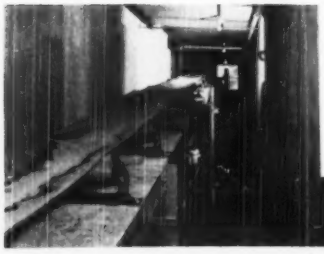
An example of the latter is illustrated here—a system for a creamery plant in Missouri. The same economical planning, survey, and engineering went into this installation that goes into Fairfield's largest power plant installations. For efficient, economical recommendations on your power plant operation, call in your Fairfield Engineer today.

THE FAIRFIELD ENGINEERING COMPANY

335 Chicago Ave. Marion, Ohio

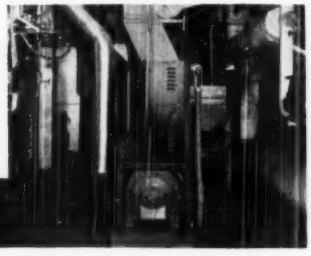


Centrifugal discharge type vertical Elevator provided with two-way discharge hopper for optional ground storage.



16" Belt Conveyor receives coal from track hopper regulating gate and delivers to elevator.

Double strand type Flight Conveyor mounted over coal bunkers and equipped with discharge gates and chutes.

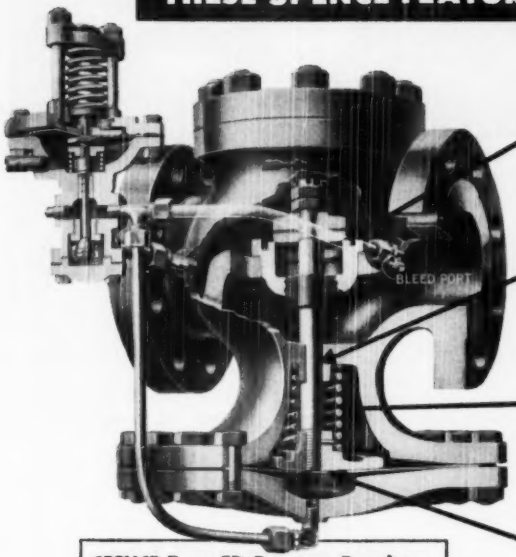


Steel hopper bottom type Coal Bunker fitted with drip and sift proof gates.

HERE'S PROOF

You Can Cut Costs of Pressure and Temperature Control

THESE SPENCE FEATURES SHOW YOU HOW



SPENCE Type ED Pressure Regulator

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. More than twenty years of experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

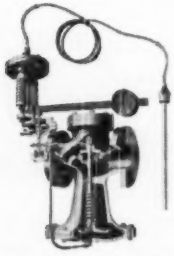
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

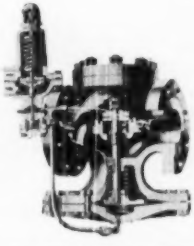
LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

YOU BENEFIT by these and many other Spence features that assure *accurate, dependable* regulation year after year. That means *less down-time, less time and money wasted on replacement of parts.*

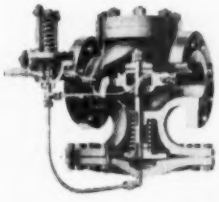
Spence Pressure and Temperature Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* Only minor adjustments are needed to switch any Spence Regulator from one service to another.



Type ET150 Temperature Regulator—Tops in performance for both storage and instantaneous heaters.



Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



Type EQ Back Pressure Regulator — Completely packless, pilot operated for accurate control of the initial pressure.

These Companies Have Profited with SPENCE!

The Springs Cotton Mills
Ford Motor Company
Pennsylvania Power & Light Company
Jones & Laughlin Steel Corporation
National Tube Company
The Atlantic Refining Company
Great Lakes Steel Corporation
Todd Shipyards Corporation
Land O'Lakes Creameries, Inc.
General Electric Company
R. J. Reynolds Tobacco Company
Ohio Edison Company

and thousands of others

SPENCE ENGINEERING COMPANY INC.
WALDEN, NEW YORK

Spence

HERE IT IS!

Fig. 3639-3678 Self-Priming Centrifugal

Goulds NEW Self-Priming Pump

Only GOULDS gives you all five of these outstanding advantages

1. Absolutely no valves of any kind in pump—nor are any needed in installation. Liquid can drain out of discharge and suction line through pump without affecting priming ability.
2. No recirculation of liquid after completion of priming action.
3. Efficiencies comparable to quality straight centrifugal pumps are thus obtained.
4. Positive fast-acting self-priming similar to priming ability of positive displacement pumps.
5. No large or bulky priming chambers or reservoirs, providing a compact unit at low cost.

APPLICATIONS:

Any service where suction lifts are encountered. Particularly adaptable for automatic service or where liquids to be pumped contain air or gas. Pump will automatically free itself of air and positively will not vapor lock.

Open impeller type. Sump service • Sewage effluent • Marine-bilge pumping, etc. • Mine gathering and dewatering • Dewatering excavations, cellars, etc.

Enclosed impeller type. Cold and hot water • Low pressure fire service • Pumping from underground supply • Irrigation • Sprinkling • Engine jacket cooling water service • Volatile liquids and light oils • Ice core sucking.

SIZES—CAPACITIES AND OTHER FEATURES

39 Models and Sizes

¼ to 5 H.P. ratings

Open and enclosed impellers

Capacities to 120 G.P.M.

Heads to 135 ft. depending on capacities

Suction lifts to 25 ft.

Also available in Flexible coupling motor drive or belt drive and close-cupld gasoline engine-driven unit.

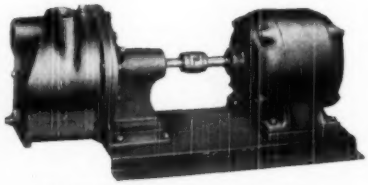


Fig. 3739-3789 Flexible coupling type drive

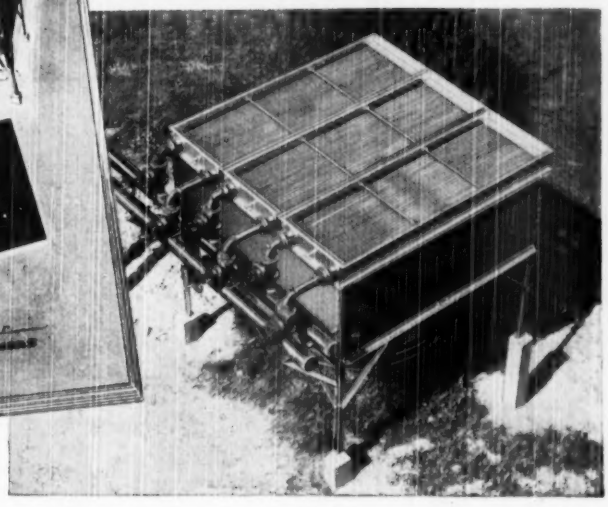
Patents Pending

FOR FULL DETAILS WRITE FOR BULLETIN 636.1

MEMBER

Goulds PUMPS INC. Seneca Falls New York

RATINGS & DATA ....YOU'LL WANT



on dry cooling equipment... DriCooler®

Whether you have an engine in a power plant — products to cool or condense in a natural gasoline plant — engines or gas to cool at a gas pipeline compressor station — high level heat dissipation in a refinery or a small standby engine to cool .... Marley has a DRICOOLER to do your job!

Small "packaged" DRICOOLERS or large industrial units are all built to give years of dependable service. All DRICOOLERS, large or small, have finned tubes that are easy to clean, quick to drain and have been tested for long life. Proven Marley mechanical equipment insures smooth, quiet operation.

DRICOOLERS are standard in forced or induced draft, horizontal or vertical coils, steel units or abestos-board covered redwood structures, and sections are available with various fin and tube materials and header arrangements.

WRITE FOR THE NEW DRICOOLER BULLETIN

- Gives rating tables for cooling water
- Lists dimensions and weights
- Shows coils, structure and mechanical equipment
- Photographs of actual installations

MAIL THIS COUPON TODAY

The Marley Company, Inc., Kansas City 15, Kansas P-8

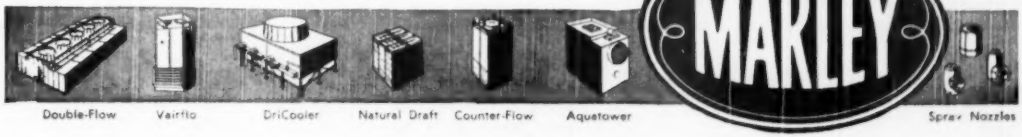
Please send me without obligation Bulletin DC-50 on the complete line of Marley DRICOOLERS.

Name _____ Title _____

Company Name _____

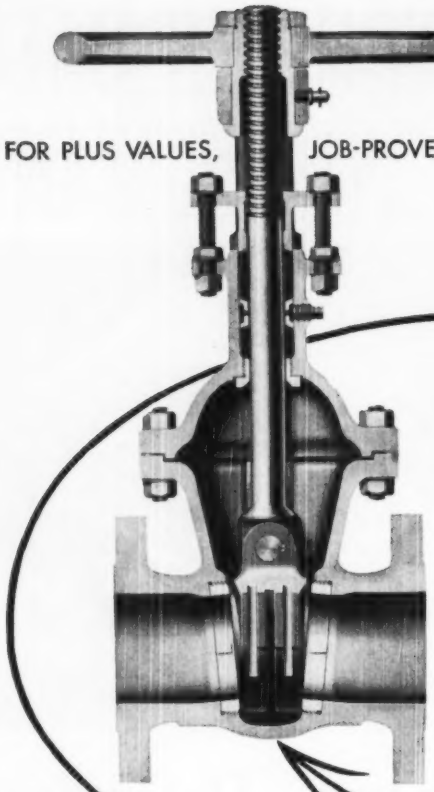
Address _____

City _____ State _____



FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

DARLING VALVES



DARLING
SLOTTED WEDGE
CAST STEEL GATE VALVE

Darling Valves for every need

Darling gate valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds. In addition to the slotted *wedge types, there are solid wedge taper seat valves and the famous Darling fully revolving, double disc, parallel seat gate valves for virtually any service.*

It's so easy to cinch improved valve performance!

LET'S skip the details on sound metal, high strength and precision—the things you'd naturally expect in *any* quality gate valve. Instead let's consider . . .

SLOTTED WEDGE . . . *Allows compression of the wedge. Compensates for valve body expansion or contraction due to temperature changes. Thus tight closing and easy opening are assured, with far less wear and tear on wedge faces and seats.*

DOUBLE-GROOVED WEDGE . . . *Double grooves, with corresponding twin ribs in valve body, provide twice the usual bearing area for more positive, more lasting alignment. This eliminates wedge canting due to line pressure, preventing damage to downstream seat.*

Take a moment to weigh the lasting, money-saving advantage of these features. Prove to *yourself* how easy it is to profit by longer valve life, less maintenance and less trouble.

WRITE FOR BULLETIN

Simply outline your service requirements, including pertinent data, or ask for bulletin on cast steel valves.

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

MAINTENANCE-FREE

pipe line motion control is yours

...with CMH EXPANSION JOINTS

There's no longer any need to spend time and money on periodical maintenance of expansion joints. You can install CMH corrugated expansion joints and forget them . . . there's no packing to pull up or replace. In CMH expansion joints, the curvature of corrugations serves to minimize internal stresses and to provide balance of working stresses. This design coupled with advanced forming methods developed through years of research and experience assures long, trouble-free service. For a new installation or for replacement of obsolete equipment, specify CMH expansion joints for the practical, dependable answer to control of axial, lateral or radial motion in piping.

The illustrations show three typical installations of CMH Controlled-Flexing Expansion Joints.

A CMH TYPE to meet every need

CMH EXPANSION JOINTS are made as Free-Flexing for pressures up to 30 psi, Controlled-Flexing for pressures up to 300 psi and Flexoniflex for pressures up to 1500 psi, temperatures to 1600° F. Sizes range from 5/8" to 30" I. D. and larger. Available in copper, stainless steel or other alloys with flanged or welding ends.

Flexon identifies CMH products that have served industry for over 48 years.

CHICAGO METAL HOSE Corporation

1301 S. Third Avenue • Maywood, Illinois • Plants at Maywood, Elgin and Rock Falls, Ill.
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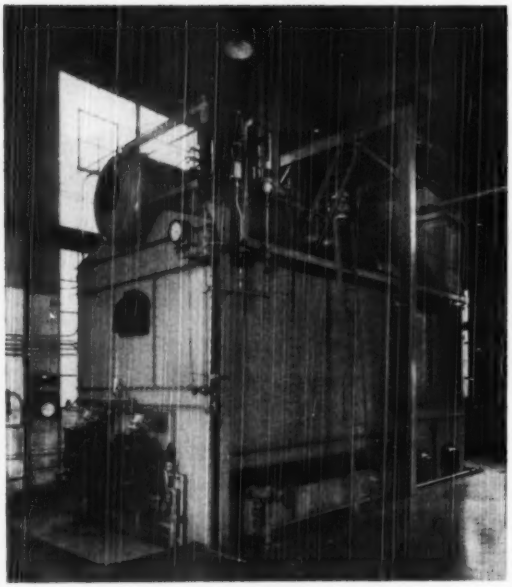
CMH

ONE DEPENDABLE SOURCE
for every flexible metal hose requirement

Convoluted and Corrugated Flexible Metal Hose in a Variety of Metals • Expansion Joints for Piping Systems
Stainless Steel and Brass Bellows • Flexible Metal Conduit and Armor • Assemblies of These Components

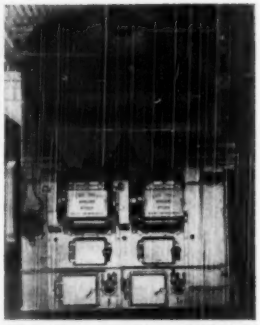
A LOW HEADROOM BOILER

That can take it



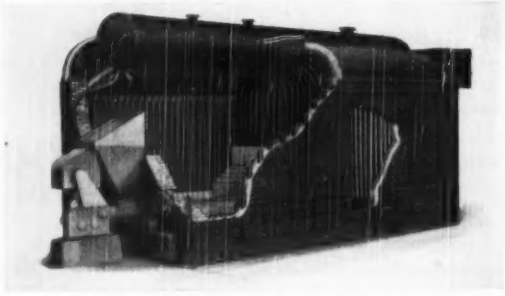
250 HP Erie City VL-Boiler oil fired at a western New York dry cleaning plant.

THIS compact, low headroom 2 drum water tube boiler features extra large water and steam capacity. Side wall water cooling reduces refractory maintenance to the vanishing point even at maximum ratings. As illustrated here the VL is well adapted to all firing methods. The VL's all steel casing and trim appearance makes any boiler room a showroom. It is recommended for sizes to 750 HP and is furnished as a completely shop assembled unit in sizes to 300 HP and larger depending upon railroad clearances.



160 HP Erie City VL-Boiler fired by Erie City Spreader Stoker in an Ohio automobile manufacturing plant.

200 HP Erie City VL-Boiler fired by Erie City Underfeed Stoker in a western paper products plant.



Outstanding of many VL features is the ring-flow circulation in each side wall element. A downcomer tube for each pair of radiant (riser) tubes in the side wall with auxiliary front wall downcomers assure an ample supply of clean circulating water in the walls at all times. Tile between riser and downcomer tubes assures rapid and unrestricted circulation.

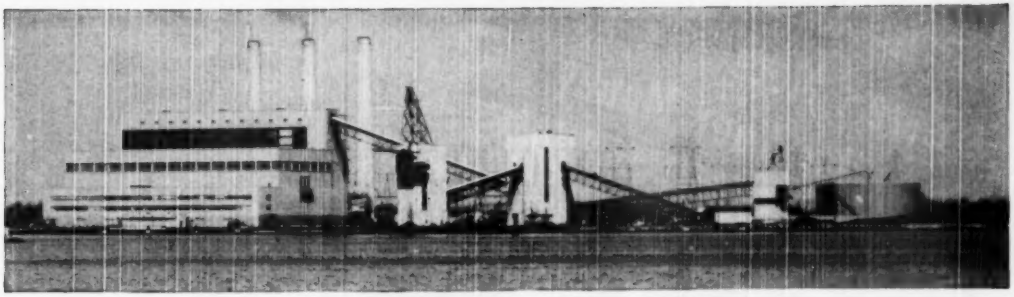
FOR COMPLETE DATA
***write for* BULLETIN SB24B**

COMPLETE STEAM POWER PLANT EQUIPMENT

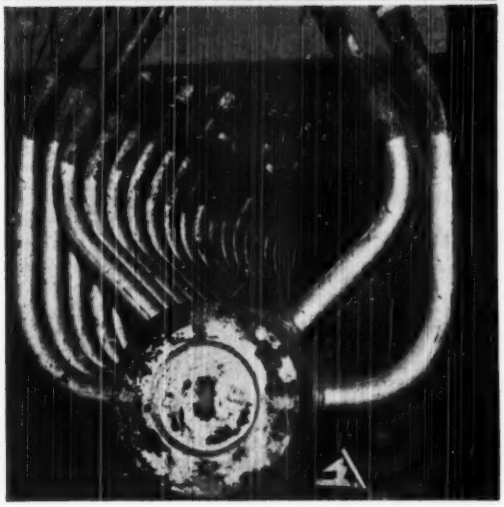
ERIE CITY

Complete Steam Generators • Type C 3-Drum Boilers • Types VL & VC 2-Drum Boilers • "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • "Keystone" Packaged Steam Generators • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*



A new high in boiler efficiency



Sewaren uses 1500 psig 1050-F steam and Boiler Tubes of U·S·S Stainless Steel

● The Sewaren Generating Station* is a modern miracle of efficient design. Plant heat rates improve steadily as each new unit goes on the line.

National Seamless Boiler Tubes, made from heat-resistant U·S·S Stainless Steel, have an important place in this new generating station. They permit the continuous, high-pressure, high-temperature operation that is absolutely necessary for most efficient power production. These tubes lend themselves well to the most complicated fabrication. Furthermore, the outstanding corrosion-resistance of National Stainless Boiler Tubes is solid assurance of long, trouble-free service . . . lower maintenance costs . . . *less down time.*

Take a tip from the men that planned this nationally-known generating station: For new boilers, or for re-tubing jobs, use National Seamless throughout. National Seamless Tubes are pierced from solid billets of steel . . . the *only* process that completely removes all uncertainty regarding uniform wall strength.

*Public Service Electric and Gas Company, Newark, New Jersey.

NATIONAL TUBE COMPANY, PITTSBURGH, PA.
(Tubing Specialties Division)
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

NATIONAL *Seamless*
BOILER TUBES
UNITED STATES STEEL

Here's More for Your Money ... IN CLARAGE UNIT HEATERS

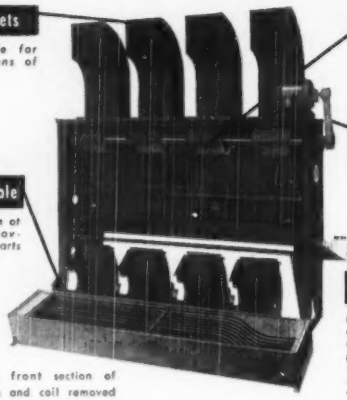

Square Outlets
Easily adjustable for different directions of heat discharge.
Centrifugal Fans
One for each heater outlet. Pressure type, delivering heat over wide areas.
V-Belt Drive
For quieter operation, greater flexibility of fan capacity. (Direct connected units can be furnished.)
Readily Accessible
Front or back section of casing quickly removable. All working parts easy to get at!
Syncrotherm Control
Regulates temperatures by controlling (with by-pass dampers) amounts of air passing through and around heating coil. Can be automatically or manually controlled.

Illustration shows front section of casing, fan housings and coil removed

SYNCROTHERM CONTROL, found *only* on Clarage Unitherms, gives you a PLUS value in factory heating! This device s-t-r-e-t-c-h-e-s your fuel dollar by utilizing *lower temperature air.*

Unitherm heat is more closely regulated, more evenly distributed floor-to-ceiling. To answer your particular requirements for either steam or hot water units, suspended type as well as floor model Unitherms are available . . . and in a wide range of sizes.

Yes, for *better* factory heating at *lower* cost, Clarage Unit Heaters — and Syncrotherm Control — merit your investigation. Check with Clarage application engineering office nearest you, or write us at Kalamazoo.

Clarco Heaters

. . . for smaller jobs, or to add capacity to present heating equipment. Wide size range of both horizontal and vertical units, steam or hot water types.

We Also Make: **Complete Line of Industrial Blowers and Exhausters . . . Air Conditioning Equipment . . . Mechanical Draft Apparatus**

CLARAGE FAN COMPANY - *Kalamazoo, Michigan*

CLARAGE

—HEADQUARTERS for Air Handling and Conditioning Equipment

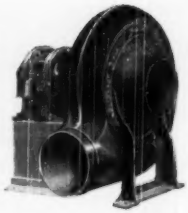
SEE OUR CATALOG IN SWEET'S

It pays to direct fan inquiries our way . . . phone Clarage office in your city, or write us at Kalamazoo.

Application Engineering Offices in All Principal Cities

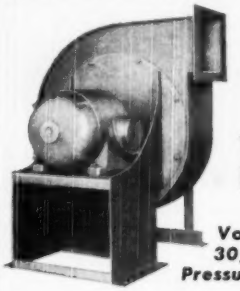
Capacities to 4000 CFM

Pressures to 20"



THREE Economy Answers to Industrial Air Handling Problems

1 **TYPE CI EXHAUSTERS** are built to the *same exacting standards* as the largest Clarage equipment; *heavy-duty* in every sense of the word! Widely used for removing excess heat, smoke, odors from manufacturing operations . . . in pneumatic conveying . . . supplying air to oil burners, as over-fire fans, etc. Regularly furnished with corrosion-resisting cast iron housings, or in any special construction your special needs demand.

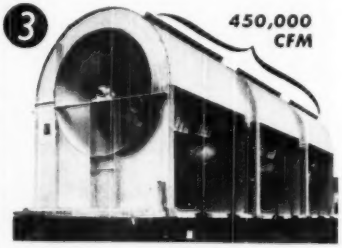


2 **Type O Blowers**

Volumes to 30,000 CFM
Pressures to 35"

For *higher pressure*, larger capacity applications . . . supplying air to cupolas, industrial gas and oil burners, etc. Fan housings and wheels of heavy steel plate "take in stride" toughest operating conditions. Clarage Type O blowers are built in 19 sizes; operate at speeds *most economical* for direct motor or turbine drive.

3 **450,000 CFM**

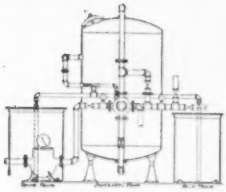


CLARAGE BUILDS equipment *big enough for ANY air handling requirement.* Example: these three Type W Fans recently shipped to a steel plant, and now installed in a large building where gas engines generate electricity. They dilute escaping toxic gas fumes, thus providing safe air for workers. Each fan delivers 150,000 cubic feet of air per minute; must operate continuously. Their *heavy-duty* qualities insure uninterrupted service on this essential job.

CLARAGE FAN COMPANY, Kalamazoo, Mich.

ILLCO-WAY DE-IONIZER TREATS 300 GPM OF BOILER-FEED MAKE-UP WATER AT THE DOW CHEMICAL PLANT, FREEPORT, TEXAS

Dissolved solids and silica removed by ionXchange... CO_2 removed by degasification



ILLCO-TEMP SOFTENER

...for removal of residual hardness from the effluent of hot or cold lime-soda units—*without chemical after-treatment.* Chemical savings from this alone will normally pay for equipment in less than 2 years. Reduction of effluent from lime-soda units to "zero "hardness produces real operating economies. Scale-forming salts are eliminated. No after-precipitation in the lines, pumps, pre-heaters, or the boilers themselves.

Softener is easily added to hot lime-soda water softener. Unit operates economically and continuously at temperatures as high as 250° F or higher . . . on waters having a pH as high as 10.5.

The De-ionizing unit shown above treats 300 gpm of water used as make-up in the power plant of The Dow Chemical Company, Texas Division, Freeport, Texas. The power plant operates seven Riley boilers, each at 250,000 lb. per hr., at 400 lb. 750°. These gas and oil fired steam generating units serve six turbo generators.

According to the plant's chief engineer, the most significant advantage resulting from the installation of this De-ionizing unit was the improvement of steam quality... "which has resulted in a marked increase in the duration of satisfactory operation of the turbine units between washing periods."

Figures given in the chief engineer's report indicate that the equipment has enabled the plant to reduce phosphate additions by approximately 60%, further assisting in the reduction of the total solids within the boiler while still maintaining a proper phosphate ratio.

Below is an analysis of the raw water prior to treatment and an analysis of the final treated De-ionized water.

Raw water analysis		De-ionized water analysis	
Ca -12 ppm	HCO_3 -126 ppm	Total hardness as $CaCO_3$	-0.5 ppm
Mg -14 ppm	Cl -164 ppm	Na	-6.0 ppm
Na -188 ppm	SO_4 -140 ppm	CO_2	-2.5 ppm
pH -9.0	SiO_2 -8.5 ppm	SiO_2	-0.2 ppm

Write for full descriptive literature covering Illco-Way De-ionizing equipment.

ILLCO-WAY DE-IONIZING DE-ALKALIZING SOFTENING

ILLINOIS WATER TREATMENT CO., 853-8 Cedar St., Rockford, Illinois • 7310-NN-8 Empire State Bldg., New York City

Cast iron
Plain case
Plain ring

Cast iron or cast brass
Plain case
Screwed ring

Cast iron
Flanged cast
Plain ring

Cast iron or cast brass
Flanged case
Screwed ring

Cast iron or cast brass
Flanged case
Flared ring

Cast iron or cast brass
Flush mounted

Phenol
Flanged case
Screwed ring

Drawn steel
Plain case
Plain ring

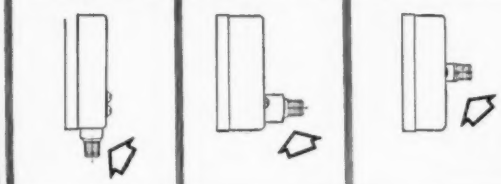
Drawn Steel
Square case
Plain ring

Drawn brass
Plain case
Screwed ring

Drawn steel
Flanged case
Plain ring

Drawn steel
Flush mounted

Available with bottom, lower back, and center back connections



Getting down to cases...

. . . here are some of the many available in Marsh Gauges

Not content with merely making the finest of pressure gauges, we make them in the widest range of types, pressure ranges, dial sizes, case patterns and case finishes.

As an example of how far we have gone in making gauges ideally suited to every need we show here just a part of the many case patterns available in Marsh instruments. Every type of case, every kind of mounting, every form of connection is represented here . . . and they are available in just about every material and finish.

Because the Marsh line offers highest quality instruments in every conceivable form, they have been accorded top preference by the most exacting users of pressure gauges. Why accept less than the instruments which have become "The Standard of Accuracy?"

Ask for catalog. It covers the scope of Marsh gauges in pressure vacuum, compound, altitude, hydraulic, sprinkler, ammonia, retard, test and diaphragm types. Marsh products also include dial thermometers, heating and refrigeration specialties, and the Electrimatic line of refrigeration regulators and solenoid valves.

MARSH INSTRUMENT COMPANY
Sales affiliate of Jas. P. Marsh Corporation
Dept. F, Skokie, Ill.
Export office 155 E. 44th St. New York, N.Y.

MARSH GAUGES

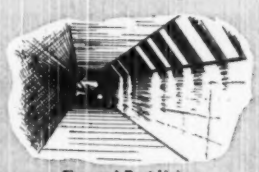
THE STANDARD OF ACCURACY

WHERE TO USE LUMNITE IN POWER PLANTS

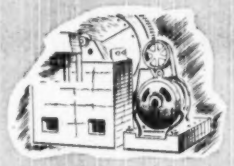
Steel Stack Linings

Ash Pit and Cinder Catcher Linings

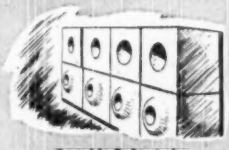
Coal Bunker Linings



Flue and Duct Linings



Overnight Structural Concrete



Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job, cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meet different temperature and insulation needs are made by manufacturers of Refractories, sold by their distributors.

P-L-16

In new stacks or old...

PREVENT CORROSION ...BOOST DRAFTS

with LUMNITE* Stack Linings

LUMNITE adds years of service to old stacks. In new stacks, LUMNITE concrete protects the steel indefinitely.

Steel stacks, new or old, get full protection from corrosion and heat when LUMNITE linings are installed. Linings made with LUMNITE and insulating aggregates boost drafts by keeping gas temperatures up and protect against overloading. They resist attacks of condensate and sulphurous gases and the smooth jointless linings allow no "breathing." In addition, LUMNITE linings in breechings withstand the abrasive action of high-velocity gases and fly ash.

LUMNITE linings are easily installed. Reinforcing mesh is attached to steel angles or other projections welded to the steel shell. The mixture of LUMNITE and insulating corrosion-resistant aggregate is applied over the reinforcing mesh. Maintenance costs are low. Outage time for repairs is kept to a minimum because LUMNITE reaches service strength in 24 hours or less.

Besides stacks and breechings, other power plant installations are listed in the column at left. Depending on requirements, LUMNITE provides high structural strength, high heat resistance and low thermal conductivity. Write for free booklets giving complete information on LUMNITE for stacks, and many other refractory, insulating, corrosion and heat resistant concrete installations throughout the power plant.

**"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

Lumnite Division

UNIVERSAL ATLAS CEMENT COMPANY

UNITED STATES STEEL CORPORATION SUBSIDIARY

135 EAST 42nd STREET • NEW YORK 17, N. Y.

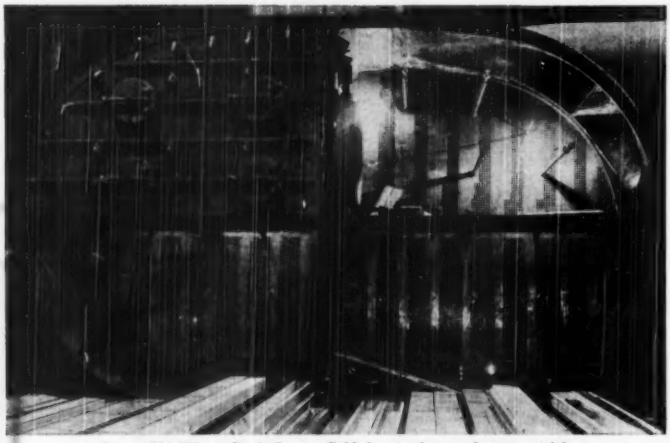
NBC SUMMER SYMPHONY CONCERTS—*Sponsored by U.S. Steel Subsidiaries—Sunday Evenings—June to September*

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*



A new 100,000 sq. ft. single-pass divided water box condenser containing about 85 miles of Arsenical Admiralty Tubes — Courtesy of Allis-Chalmers.

The Power Picture

Increased production, greater reliability stressed

Steadily mounting uses of electricity are spurring what is expected to be a tripling of load in the next 15 years.

Not only are peak loads growing but differences between summer and winter loads tend to become less. Generating capacities must be increased to provide for off-peak maintenance outages.

According to a recent forecast made by McGraw-Hill, it is estimated that the total capability in 1950 will be 67½ million kw; in 1951, 74 million; in 1952, 78¾ million; and in 1953, 83 million. By 1955, installed capacity and non-coincident peak loads are expected to reach 92 million kw of capacity and 80 million kw in peak.

In 1965, generating capacity should approach 200 million kw, producing over 750 billion kwhr for an energy sale of around 650 billion kwhr.

Since 1949, reserve margins have grown, until today they are about 16% for the country as a whole. Many operators feel that improvements in continuity of operation and better maintenance make it unnecessary to have reserve margins as large as formerly.

Design Trends

These factors are exerting a strong influence over design trends. Design effort in steam generating capacity is concentrated on increasing reliability, as a relatively minor failure of a component can shut down an entire large generating unit. This will be accentuated as there is progressively greater resort to automatic control.

Construction and operating costs are also important factors in design. An important item in plant cost reduction is the trend toward increasing the unit size.

High construction costs have been offset in many regions by installing equipment outdoors. Higher steam temperatures are more frequently adopted. Recent improvements in cooling tower practice indicate that availability of condensing water will be less in the way of site selections.

Condensers are being designed to permit cleaning in service to reduce outage time. Divided water boxes or multiple designs arranged to facilitate cleaning under part-capacity are the trend. A by-pass for reversal of flow, positive measures to prevent leakage and minimize condensate cooling are reported by many plants.

Reducing Corrosion

Special attention is being given to the selection of condenser tube alloys that will stand up under future loads and conditions. This is necessary because of the accent on more continuous operation and higher water velocities and more severe corrosive conditions.

For these reasons considerable interest is shown in such alloys as aluminum brass, aluminum bronze, and various cupro nickel alloys. Some operators carry on service tests with other alloys for information of their behavior for use in future selection when present installation must be replaced.

Rolling-in condenser tubes.

The complexity of the corrosion problem allows no easy answers. Corrosive conditions vary from locality to locality, and, in any given section, from season to season. Careful study of various alloys under specific conditions helps in making a selection that will give long and reliable service.

Bridgeport's corrosion laboratory will be glad to work with operators on these difficult corrosion problems. Many fine alloys are available that are suited to different conditions. Useful information on these alloys and their application is given in Bridgeport's 120-page "Condenser Tube Manual." A copy will be mailed to those sending requests on company letterhead.

BRIDGEPORT BRASS

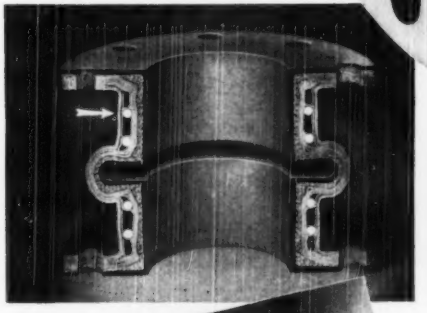
BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

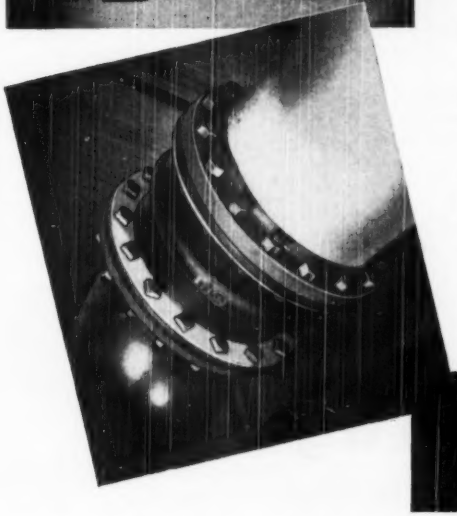
Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

(Advertisement)

STANDS UP under Repeated Flexing!

Note sturdy construction. The arrow in photo below points to one of the steel reinforcing rings.





GARLOCK RUBBER EXPANSION JOINTS

resist cracking and corrosion— and do not take a permanent set

GARLOCK RUBBER EXPANSION JOINTS hold up under repeated flexing caused by expansion, contraction and vibration of the pipe line, because they are constructed of high grade rubber which is combined with plies of sturdy cotton duck and reinforced with steel wire or rings. Where oil resistance is necessary, neoprene joints are available.

For all pipe sizes from 2" to 72", including tapered joints. Specify No. 204 for *Pressure;* 205 for *Vacuum;* 206 for *Pressure and Vacuum.* Write for descriptive folder.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK

Because they're years ahead in steam generation . .

only

CYCLOTHERM
STEAM
GENERATORS

Trade Mark Reg.

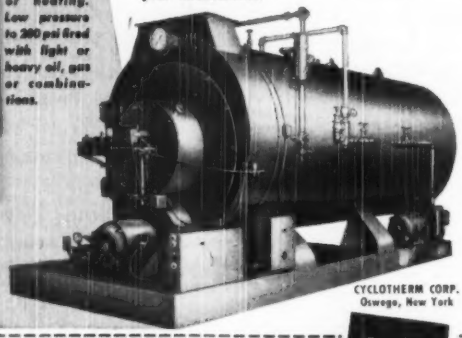
have cyclonic* combustion POWER

*WHAT IS IT? It's the modern scientific discovery of transferring heat at the highest degree of efficiency with a new low in fuel consumption. Principal factors of which are the cylinderized solid flame with its exclusive cyclo-motion power, designed to utilize the full potential of every particle of fuel . . . and the thin layer of air resulting from centrifugal force that's always between the flame and wall of combustion chamber. A combination to produce steam far in excess of conventional standards for measured heating surfaces.

SEND FOR ALL THE BIG REASONS

Learn how the completely automatic Cyclotherm with its unexcelled all-in-one package type features wipe out waste and excess costs. If you are planning a new or replacement boiler installation it will pay you to first get the facts on Cyclotherm. The coupon below is for your convenience.

SIZES available to fit your steam or water load for processing or heating. Low pressure to 300 psi fired with light or heavy oil, gas or combinations.



CYCLOTHERM CORP.
Oswego, New York

CYCLOTHERM CORP., OSWEGO, N. Y.

Gentlemen: Please send me bulletin P-1 showing the advantages of Cyclotherm's new concept in Heat Transfer. Without obligation, of course.

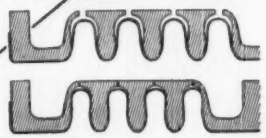
DEPT. P8

NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

D-F S-E*



*EXPANSION JOINTS

The importance of D-F S-E to you may be measured in dollars. Maintenance costs are reduced to a minimum. Initial cost is amortized over a long life. Case histories show BADGER D-F S-E EXPANSION JOINTS installed in the early thirties are still on the job.

D-F S-E could mean *definite financial savings effected* —actually D-F S-E does mean **Directed-Flexing Self-Equalizing.* Directed-Flexing, an exclusive construction feature in Badger Joints, is a combination of an all-curve corrugated member and correspondingly shaped Self-Equalizing rings which not only limits the movement of each corrugation but also progressively controls each increment of movement over the area of each corrugation. This construction eliminates localized stresses which cause metal fatigue and break-downs.

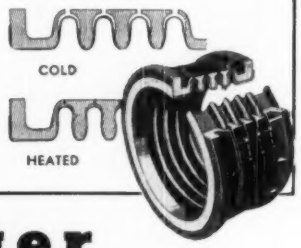
Send today for new 24-page catalog

All-curve flexing guarantees longer life

Badger Joints flex like this . . .

not like this . . .

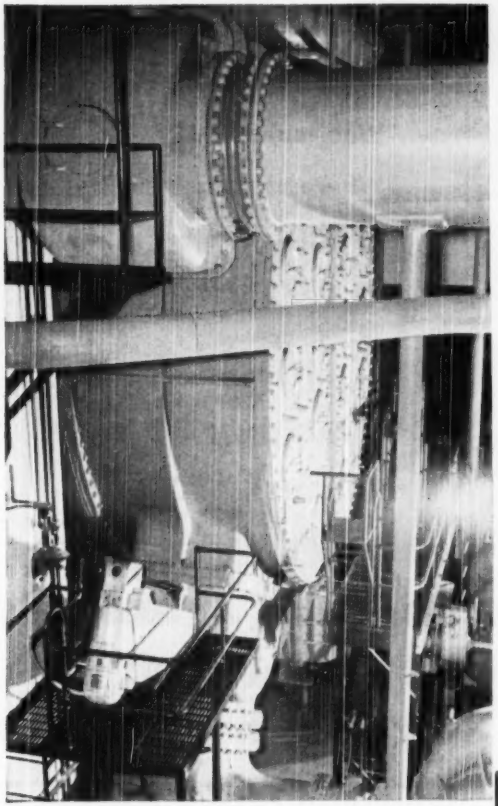
. . . this stress-free flexing principle exclusive with Badger



Badger
MANUFACTURING COMPANY
230-260 BENT STREET CAMBRIDGE 41, MASS.

"SELF-CLEANING" CONDENSER

Eliminates 2 to 3 HOURS Daily Down-time



HERE'S HOW THE "REVERSE FLOW" PRINCIPLE WORKS ⟹

Both halves of this Dual Bank Condenser work the same but independently of each other.

Left Side: Water enters divided water box at valve chamber A, with left port open. It flows through pass B to end of condenser, back through pass C and out through upper port of D.

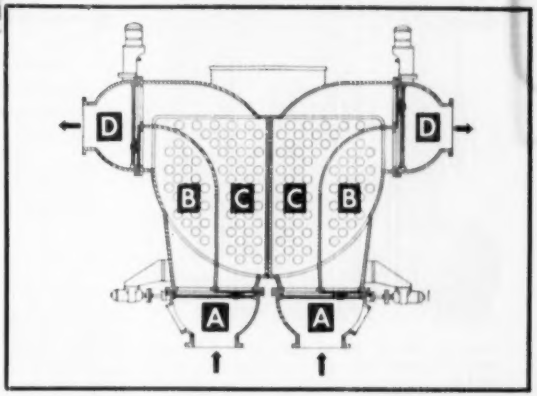
Right Side: Flow is reversed: Valves at inlet A and discharge D are changed to permit water to flow through C and back through B in the opposite direction, then out through lower port of D.

At Plant Atkinson, Harryat, Georgia, the Georgia Power Company draws circulating water from the Chattahoochee River. The inevitable sand, gravel, twigs and leaves used to clog condenser tubes and tube sheets in a matter of hours. Before the installation of a C. H. Wheeler Reverse Flow "Self-Cleaning" Condenser, it was a two- to three-hour job every day to remove anywhere from ½ to 2 yards of debris by hand. During this time, it was necessary to drop the load on the turbine to about half in order to operate against excessive back pressure.

Since September 5, 1949, when a C. H. Wheeler "Self-Cleaning" Condenser was installed, there hasn't been a single shut-down for cleaning. The Reverse Flow mechanism works flawlessly 24 hours a day, with 70,000 gallons per minute of river water passing through. The only cleaning is done by means of the electrically operated valves that reverse the flow of water through the condenser without interfering in any way with plant operation. This is done as often as necessary in a matter of minutes.

Through eliminating down-time for condenser cleaning, approximately *one month* of full capacity operation is added to the service of one of the four 60,000 KW turbo-generators in this 240,000 KW plant.

You, too, can benefit by C. H. Wheeler Engineering. Whether or not you need the self-cleaning Reverse Flow feature, it will pay you to "Investigate C. H. Wheeler Condensers before you Invest."



C.H. Wheeler OF PHILADELPHIA

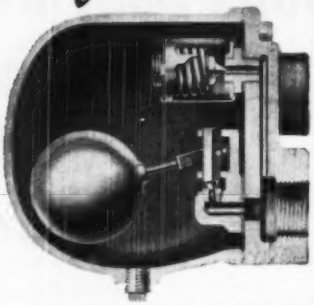
STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

C. H. WHEELER MANUFACTURING CO., 1800 SEDGLEY AVE., PHILADELPHIA 32, PA.

REPRESENTATIVES IN MOST PRINCIPAL CITIES

REMOVES AIR AND CONDENSATE *as fast as formed...*

SARCO FLOAT THERMO-STATIC STEAM TRAPS



Discharges condensate continuously without shock to disturb temperature controls. Keeps unit heaters, hot water generators and steam lines fully operative at all times. Note the automatic by-pass for air. Air binding is impossible. The FT is tops for continuous food and chemical processes and low, medium and high pressure heating systems. Catalog No. 450.

287

SARCO SAVES STEAM

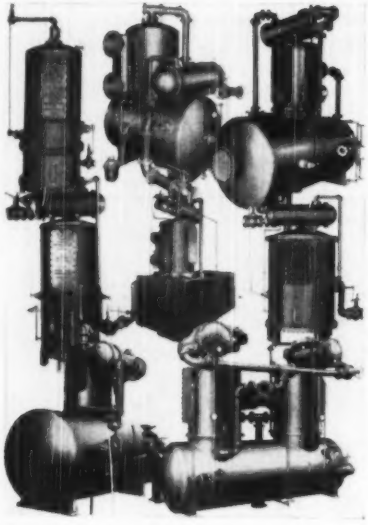
SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

FOR YOUR CONVENIENCE

When you are looking for the answers to
"What's available?"
"Who makes it?"
"Where can I get it?"
—you'll find them quickly and easily in the

1950 Mid-June
POWER Buyers' Guide Number
KEEP AND USE *YOUR* COPY



Partial line-up of Stickle Open Coil Feed Water Heaters — deaerating and non-deaerating types. Available in 10 standard sizes in single heaters; 6 sizes in dual heaters.

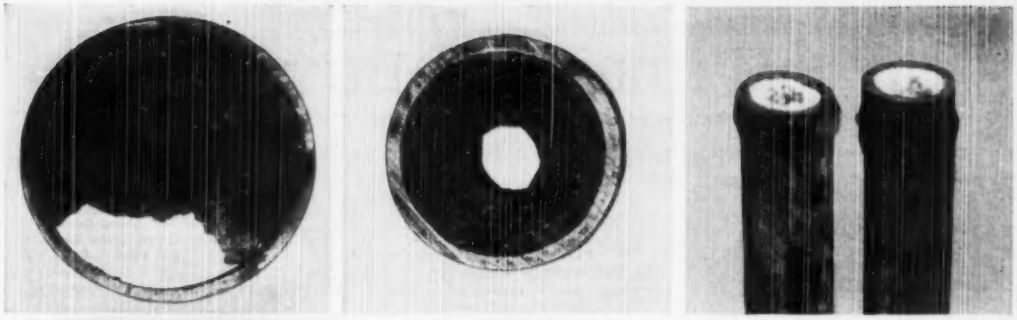
Raise the quality of feed-water —Lower the cost of fuel! with STICKLE Open Coil HEATERS

Relieve the temperature strain on your boilers—reduce costly scale—by preheating feed-water with Stickle Open Coil Heaters! Steam condensed in heating feed-water provides one-sixth of your boiler feed supply—every bit of it *pure* water, distilled and free from minerals and non-condensable gases. Stickle Open Coil construction brings feed-water into direct contact with the steam . . . immediately transmits heat from steam to water at the temperature of the steam in the heater shell . . . *cuts your fuel costs 10-15%!*

Stickle three-section, circular trays provide extra surface—heat more water to higher temperatures in less height than any other heaters on the market. Heaters are available in a variety of sizes to suit your particular space requirements—in capacities ranging from 3,000 to 250,000 pounds. *Get all the information! Send for free, detailed Stickle Bulletin No. 117 today.*

STICKLE STEAM SPECIALTIES CO.
2265 VALLEY AVENUE • INDIANAPOLIS, INDIANA

STICKLE EQUIPMENT



THESE PARTS WERE TAKEN

Out of Service

BECAUSE OF SCALE

DEARBORN FORMULA 134 ELIMINATES SCALE

● These destroyed parts represent a large, unnecessary investment in equipment, labor and shut-down time. Conditions like these can easily and economically be avoided with Dearborn Formula 134. Wherever water travels—scale tends to form. Formula 134 is a concentrated solvent for the rapid removal of scale in heat exchange units, boilers, pumps, feed lines, meters, condensers and other valuable equipment.

Formula 134 is just one of many Dearborn formulas used to save equipment, reduce shut-down time and maintenance costs. Other Dearborn formulas control acidity of condensate, prevent excessive foaming and prevent corrosion of metal in contact with calcium and sodium chloride refrigerating brines. For the correct water treatment to best meet your needs—consult Dearborn.

DEARBORN CHEMICAL COMPANY
310 S. Michigan Ave. • Chicago 4, Ill.

SAFE, SIMPLE APPLICATION

with specially designed, inexpensive pump also supplied by Dearborn! Send for Bulletin 5002 which describes in detail methods for the removal of scale with Dearborn Formula 134.

DEARBORN CHEMICAL COMPANY
310 S. Michigan Ave., Dept. PO
Chicago 4, Illinois
Gentlemen:
Please send me information on Dearborn Formula 134.

Name.....
Company.....
Address.....
City.....State.....

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

WATER TREATMENT AND SOFTENING COMPOUNDS • COMPLETE ENGINEERING SERVICE • NO-OX-ID RUST PREVENTIVES

WHERE TO BUY

Featuring additional products specialties and services for power plants

STICHT FOR TACHOMETERS
HERMAN H. STICHT CO., INC.
37 PARK PLACE N.Y.C.

"MONO"
BOILER BAFFLES
HIGH TEMPERATURE
Refractory Cements
SANFORD C. SMITH REFRACTORIES, ONC.
1715 NIAGARA ST., BUFFALO, N. Y.

ERNST Liquid Level Gages
High and Low Alarm Columns
Split-Gland Water Gages
Sight Flow Indicators
Flat Glass Inserts
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Consulting and Designing Engineers
Kansas City, Mo. P. O. Box 7088 — Cleveland, Ohio 1404 E. 9th St.

NO TIME TO EXPERIMENT . . .
So why not save time by calling in a specialist who knows the ground you are exploring?
POWER, meeting place of power men in all parts of the country, points the way to the solution of many power problems through its Professional Service Section.

SARGENT & LUNDY
Engineers
140 South Dearborn St. — Chicago, Illinois

THE H. K. FERGUSON CO.
Industrial Engineers and Builders
POWER PLANT DEVELOPMENT, ENGINEERING AND CONSTRUCTION
The Ferguson Building, Cleveland, Ohio
Chicago • Houston • Los Angeles • New York City

J. E. SIRRINE COMPANY
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Power Plants — Consultations
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Engineers and Consultants
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Referee and consulting—industrial wastes, water supplies, purification, pollution, feed and boiler water control.
Reagents, test kits, water-conditioning equipment.
— 25 years specialization —
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Engineers - Constructors
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THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
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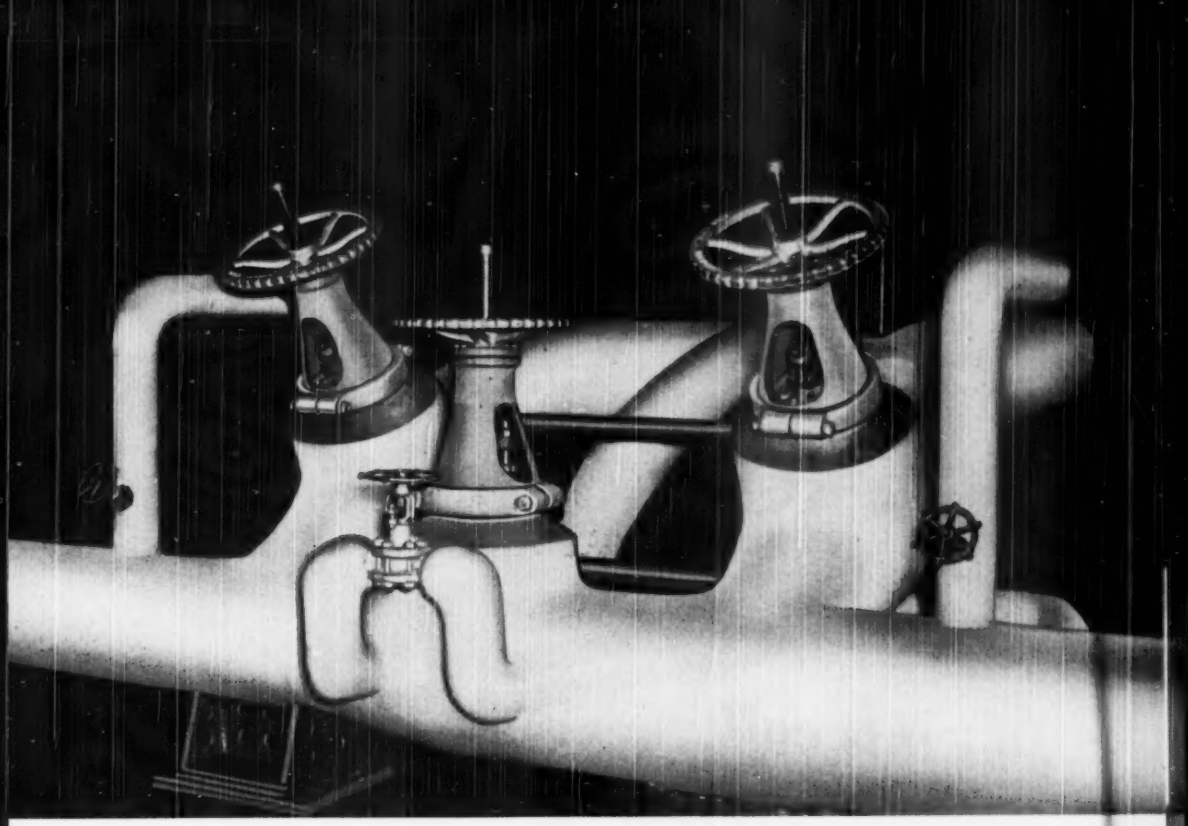
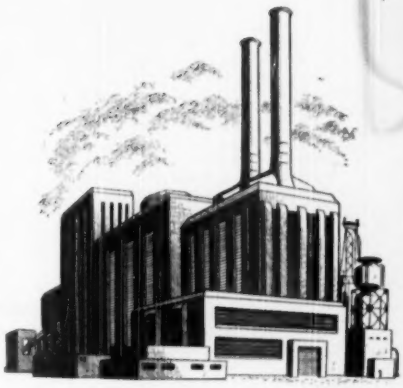


FORGET IT!

OUT OF SIGHT, down under the coal bunkers, this Blaw-Knox piping assembly supplies feed water to main boilers in a great new Wisconsin power plant—temperature 450° F., pressure 1350 psi. In spite of its importance, it will soon be forgotten, for it functions without attention—out of sight!

The assembly was designed and built to outlive the big plant of which it is a vital part. Blaw-Knox engineers, fabricators, and erectors stake an enviable reputation on the life-long services rendered by Blaw-Knox Power Piping.



POWER PIPING DIVISION
OF BLAW-KNOX CONSTRUCTION COMPANY
1525 Pennsylvania Avenue, Pittsburgh 12, Pa.

BLAW-KNOX *Power Piping*

was this call necessary?

Some "Moral Insurance" here might have avoided a serious accident

Workmen's compensation is a fine thing—but it can't replace a mangled arm.

Safety laws prevent many accidents—but they can't cover every hazard of an individual plant.

Accident prevention which goes *beyond the law* is an unwritten responsibility of every employer. It is his "Moral Insurance" for his employees welfare.

The premiums for "Moral Insurance" are not high. They do not have to be paid for in fancy safety gadgets. Their cost is simply the institution of common sense safety regulations covering all local hazards—enforced by employee committees with the full support of management.

Yes—"plant safety" is a mutual job.

DON'T FORGET—THE LIFE YOU SAVE MAY BE YOUR OWN

Published in the public interest by:

McGRAW-HILL PUBLICATIONS

SEARCHLIGHT SECTION

Classified Advertising

EMPLOYMENT: BUSINESS: **"OPPORTUNITIES"** EQUIPMENT USED OR RESALE

—RATES—

UNDISPLAYED

$1.20 per line, minimum 4 lines. To figure advance payment count 5 average words as a line.

INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of above rate, payable in advance.

Box Numbers—Care of publication New York, Chicago or San Francisco offices count as one additional line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

New Ads Received by Aug. 9th at the New York office, 330 W. 42nd St., New York 18, N. Y., will appear in the Sept. Issue subject to limitations of space available.

DISPLAYED

Individual Spaces with border rules for prominent display of advertisements.

The advertising rate is $16.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page.

P.

REPRESENTATION WANTED

Well known arch and wall manufacturer desires active and substantial representation in Michigan territory. Power plant and industrial applications. Substantial opportunity representing 50-year-old company.

RW-7073, POWER
520 N. Michigan Ave., Chicago 11, Ill.

Engineers — Executives — Technical Men
Salaried Positions, $4,000 to $30,000

This Confidential service for men who desire a new connection, will develop and conduct preliminary negotiations without risk to present position. Send name and address for details.

TOMSETT ASSOCIATES
1205-2 Berger Bldg., Pittsburgh 19, Pa.

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42 St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

SELLING OPPORTUNITY OFFERED

WANTED—NATIONAL distributor, for product of proved value, used in power plants. Now being sold to satisfied users. RW-7153, Power.

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (40 years recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

SALARIED PERSONNEL $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept G, 241 Orange St., New Haven, Conn.

POSITIONS WANTED

CHIEF ENGINEER ex-Navy, 49, N. J. Gold seal. Will take full responsibility proper operation and maintenance H. P. steam plant 160,000 lb/hr. fuel oil-pulverizers, turbines, refrigeration, etc. Accept less responsibility in suitable plant. Present salary $5,500. PW-6982, Power.

POWER ENGINEER—Twenty-five years experience, operation and maintenance of modern power plants, electrical equipment, refrigeration, air conditioning and water filtration plants. Fifteen years high pressure plant, some construction, with a utility, industrial plant or municipality. Registered engineer, gold seal licensed power plant operator. Will relocate or travel. PW-6662, Power.

MAINTENANCE ENGINEER, age 45 with experience in crane mfg. plant, steel mill, & 30 story office bldg. Can lay out control circuits A.C. & D.C. & supervise any type of maintenance. Locate Eastern Pa., N. J., Del., or Md. PW-7178, Power.

WANTED
MACHINE SHOP SUPERINTENDENT

An excellent permanent opportunity for the right man. Applicants must have ten years' Machine Shop experience, of which five years was in responsible charge. This is a Maintenance Machine Shop located near Phoenix, Arizona. The Shop does all types and sizes of machine work, including large hydro-electric generators, steam-turbo generators and deep-well pumps. An Engineering degree from an accredited school is essential.

This is an excellent permanent opportunity for the right man. Write giving age, qualifications and salary desired. All replies confidential.

P-7091, POWER
68 Post St., San Francisco 4, Calif.

WANTED
POWERHOUSE OPERATORS

An American Oil Company operating in South America will welcome applications from well qualified powerhouse operators.
Minimum five years' experience in public utility or large industrial powerhouse. Should be experienced in operation of high pressure boilers, steam turbines, evaporator plants, switchboards, and auxiliary equipment.
These are regular staff jobs offering retirement plans and other benefits.

Write giving age, education, marital status, and detailed experience resume.

Box 308-V, Radio City Station
New York 19, New York

PROJECT ENGINEER

Wanted—Experienced Construction Engineer for large turbo-generator power plant on East Coast. Must have recent experience in directing operations for complete project, with knowledge of sub-aqueous operations and construction of docks and waterfront facilities. Write giving full particulars of education, experience and salary expected.

P-7106, POWER
330 W. 42 St., New York 18, N. Y.

POWER PLANT PERSONNEL

An east coast utility now constructing a new high-pressure pulverized fuel generating station, the first two units of which will have a capacity of 132,000 K.W., will accept applications for employment from qualified persons for the following positions. These positions will be available in the fall.

SHIFT SUPERVISORS

To take full charge of shift operation. Must be thoroughly conversant with all phases of modern high-pressure pulverized fuel power plant operation, both electrical and mechanical. Must have previous supervisory experience in power plant operation.

CHIEF OPERATOR

Responsible for the operation of two steam-electric generating units from a fully centralized control room. Will be required to direct other operators in the performance of their duties and operate the plant from the control room. Must have previous experience as an operator of pulverized fuel boilers, hydrogen-cooled turbine generators, high voltage switchboards, condensers, boiler feed pumps and all related auxiliaries.

ASSISTANT CHIEF OPERATOR

Will be required to assist the Chief Operator in directing the operation of, and operating from the centralized control room all equipment such as pulverized fuel boilers, hydrogen-cooled turbine generators, switchboards, condensers, boiler feed pumps and all related auxiliaries.

MAINTENANCE FOREMAN

Must have good background of experience and be able to direct the maintenance of all power plant equipment, such as boilers, turbines, pulverizers, pumps, fans, air compressors, coal handling, machine shop, etc. Must have good mechanical ability and be able to take full charge of maintenance crew under the direction of the master mechanic. This job to be filled immediately.

INSTRUMENT MECHANICS

Previous experience on power plant instrument work essential. Must have a good working knowledge of and be able to service and repair such equipment as automatic combustion controls, flow meters, temperature recorders, gages, pH controllers and boiler meters. Must have a good understanding of electrical circuits as well as mechanical devices.

Job is centrally located near excellent residential community, good working conditions, forty-hour week (paid vacations, insurance, sick pay and retirement plan). All personnel selected for employment will be given complete job training at full pay to familiarize them with this particular installation before assuming their regular duties.

Include complete resume of experience and qualifications in first letter, together with recent photograph. All applications will be treated confidentially.

P-6897, POWER
330 W. 42nd St., New York 18, N. Y.

MANUFACTURER'S AGENT WANTED

Midwest manufacturer of pneumatic and sluicing types ash handling systems having many successful installations has opening in several territories including Michigan for manufacturer's agent successfully handling related items. Write in detail outlining products handled and companies represented.

RW-7074, POWER
520 N. Michigan Ave., Chicago 11, Ill.

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

WRITE FOR STOCK LIST No.1622

VARIABLE VOLTAGE DRIVES

40 HP Reliance Variable Voltage Drives, each Consisting of:
1—40 KW 230 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 388T, 230 Volt, DC Motor.
With full magnetic control providing log forward, log reverse, run, fast, slow, and stop, and motor operated field rheostat.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	H.P.	Speed	Volts	Make	Type
2	7½	810	550	G.E.	MTC-4301
2	10	1140	440	West.	HF-7A
2	10	870	220	G.E.	HI-11
2	11‡	820	550	G.E.	ITC-5008
1	15	1160	440	West.	CW-464C
2	15	870	220	West.	CW-646
1	15	680	440	West.	MW-316
1	20	880	440	West.	CW-438
2	25	1130	550	G.E.	MT-323
1	25	350	220	Wagner	BR
2	25	720	440	Wagner	25VBR
1	30	865	440	West.	CW-646
1	30	350	440	G.E.	MT-332
1	30	675	440	G.E.	MT-338
2	35	600	440	F-M	HW-1154
2	40	865	2200	Al.Ch.	ARY-223C
1	40	860	440	G.E.	MT-344
3	50	1150	440	G.E.	M-336
1	50	880	440	West.	HF-12A
1	80	570	440	G.E.	MT-352
5	82‡	550	220	G.E.	IQO-6013 ***
1	60	855	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW-938
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTP-549
1	175	505	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	435	2200	G.E.	IM-17A
3	300	900	140	G.E.	IM-17
3	300	580	2200	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-315A
2	350	1200	220	G.E.	IM-17A
1	400	505	550	West.	CW
1	400	1770	440	G.E.	IM-415C
1	500**	585	440	G.E.	MT-442Y
1	700	735	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts.
‡ Intermittent rating. *** 2 phase.
** New. ‡‡ 25 cycle.

A.C. GENERATORS — NEW

2 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding and Direct Connected Exciter.

Quan.	KVA	RPM	Make	Volts
4	18.7	1800	Columbia	240/120
5	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
10	3	850	Reliance	Y-23T
25	3½	850	West.	SK-30
1	7½	850	G.E.	CDP-65
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
8	10**	1150	Al.Ch.	EB-80
2	10	850	West.	SK-93
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
8	15	825	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1150	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	730	West.	SK-150
1	50	850	G.E.	RC-16
1	60	1750/1310	West.	SK-143
1	150	730	Al.Ch.	
2	200	1150	G.E.	RC-38
1	250	1156	C.W.	CMC-101A

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
2	10/15	600/2400	Reliance	T-92T
1	12½	230/340	West.	SK-130
10	13½**	900	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	400/1600	Reliance	T-32-T
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	25/30	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40/50	400/1200	Reliance	T-4611
1	75	500/1500	Cr.Wh.	CCM
1	75	375/750	Cr.Wh.	CMC-1251
1	100	225/900	G.E.	MPC-A
3	100	400/1200	Al.Ch.	
1	100	330/990	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	350/500	West.	SK-220
1	375	350/600	G.E.	MPC

**New.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-E cP
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	20	1760	220	G.E.	K-365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	40	3565	440	G.E.	KF-4058

Splashproof, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
23	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1180	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
5	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	125	1770	440	L.A.	FX-1078Y
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335
1	200	885	440	L.A.	FS-1378

Open Type Motors

Qn.	HP	Speed	Volts	Make	Type
1	15	3485	220	Reliance	AA-53247
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RPI-384
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	KT-512
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-356***
2	25**	875	440	Master	PB-405
2	25	575	440	G.E.	KT-542
3	30	3550	550	G.E.	K-3648
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3546	220	G.E.	KP-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP5-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-546
1	75	1160	440	West.	CS-663C
1	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-552
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.Ch.	AN
2	125	433	440	Al.Ch.	AR
2	125	600	2300	G.E.	I-17-FR
1	200	585	550‡‡	G.E.	KT-5658
2	300	587	2200	West.	CS-39A
1	400	1165	2200	G.E.	IK-E16B
1	500	1200	440	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

220 volt motors can be reconnected for 440 volts
**New. ***2 Phase. ‡‡Reconnectable for 440 volts.

G. E. DYNAMOMETERS

Cradle Type, with Control and Dial Scale
(Write for Complete Specifications)

Qn.	HP	DC Volts	RPM	Type
1	50/75	250	1650/4000	TLC-20
1	200	250	1200	C

MOTOR GENERATOR SETS

125 and 250 Volts D. C.
(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
2	Const.	1750	125	220/440
7.5**	West.	1455	125	380/220§
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
10	West.	1150	250	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1735	250	220/440
15	West.	1450	125	220/440‡
16	West.	1750	125	2200/440
20	West.	1750	250	220/440
25	G.E.	1800	250	220/440
25	G.E.	1200	125	220/440
30	G.E.	1800	250	220/440
30	Al.Ch.	1750	125	220/440
50	West.	1750	250	220/440
50	G.E.	720	125	220/440†
75	G.E.*	1200	125	220/440
75	G.E.	1200	250	2300/440
100	Columbia*	1200	250	2300/440
180	West.*	1200	250	2300/440

Note: 3KW, 5KW & 7.5KW, 250 V Sets Available.
**New. *Synch. Motor Drive. §50 Cy. 125 C.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVE. CLEVELAND 14, OHIO

1—600 HP Babcock & Wilcox Cross Drum Sectional Header Boiler 290 lbs. Complete with Westinghouse stoker and all accessories—ASME. Built 1925.

2—500 HP Babcock & Wilcox Boilers. Longitudinal Drums. Built 1918. Mass. Standard. 200 lbs W.P.

4—485 HP Babcock & Wilcox Boilers. Built 1915. 200 lbs. Complete with all usual trim.

1—FF16 Babcock & Wilcox Boiler 1936. Complete with casing. No tubes. 200# w.p. includes Pulverizer. 45,000 lbs. steam Per Hr.

1—60 HP Cleaver Brooks Package Unit. 125 lbs. 1944.

1—500 KW Kerr Non-Condensing Turbine 150 lbs I.P. 10 lbs. B.P. 3 phase, 60 cycle, 2300 Volts Westinghouse Generator.

1—Turbine Driver, 2 Stage, Fuel Pump 250 GPM. 250 lbs. head. No superheat.

2—Babcock & Wilcox Chain Grate stokers for 30,000 lb. Per Hr. Boilers—1946. Used 6 weeks only.

1—Western Equipment Co. Cyclone Precipitator with automatic bark feed. 1946. Equipment located Clinton, Iowa.

Substantial quantity of other related equipment available. Ask for a complete list.

WARNER J. SHERB, INC.

342 Madison Ave., N. Y. 17, N. Y.

***Tel:* MUrray Hill 2-9098**

NEW 30 KW DIESEL GENERATOR SETS

A.C. 6 Cylinder Diesel engines, direct connected to: 30 KW General Electric Alternators, 3 phase, 50 cycle, 220/380 volts, with belt driven exciters, including self-contained panel, automatic voltage regulator and spare parts. Limited quantity; immediate shipment.

ALJOHN DIESEL CO., INC.

904-10 Pacific St. Brooklyn 16, N. Y.

STerling 3-4515

DIESEL ELECTRIC GENERATORS

1—G.E. (NEW) 750 KW, 2400/480 Volts, 3/60, 720 RPM.

2—Crocker Wheeler (NEW) 600 KW, 2300/460/3/60/720.

2—Westinghouse (NEW) 500 KW, 2400/480/3/60/720.

Each direct connected to General Motors Diesel Engine and complete with new, modern Switchboard.

SEE THESE UNITS OPERATE UNDER FULL LOAD IN OUR PLANT.

SUNDFELT EQUIPMENT CO., INC.

220 Hudson Street Seattle 8, Wash.

NEW IN ORIGINAL CRATE

2—Ingersoll-Rand Air Compressors 150 C.F.M. 400# pressure complete in every detail. At present turbine drive, can substitute Electric motor or diesel engine.—$25.00.00

PAUL JAY

50 EXETER STREET BROOKLYN, N. Y.

Diesel Engines for Sale

2 Venn-Severin 75 HP Diesel Engines

400 RPM, Mfg. in 1938, belted connected to 60 KVA General Electric 3 phase, 50/60 cycle, 220 volt alternators.

Price .....$1,500.00 Ea.

Can be inspected on original foundation under power.

Excellent condition.

A. J. WINSTON

517 South Delaware Street

Indianapolis 4, Indiana

Puzzled about Buying Power Equipment?

Just remember the

HEMPHILL SEAL

it means equipment

- SELECTED BY EXPERTS
- REBUILT AND TESTED
- UNDER SUPERVISION OF
- HEMPHILL ELECTRICAL ENGINEERS
- GUARANTEED PERFORMANCE

TRANSFORMERS — 60 Cycle

Qu.	KVA	MAKE	TYPE	Ph.	VOLTAGES
1	1000	GE	Auto	3/2	4150 x 2406
1	1000	GE	Auto	3	3810Y-2300Y
1	500	Kuhl.	OISC	1	4600 x 2300V.
3	400	GE	H	1	6900 x 2250V.
1	300	Pitts.	ODSC	1	7800 x 440V.
3	300	GE	H	1	2400 x 120/240
1	200	Whse.	Auto	3/2	4150 x 2300
1	200	Pitts.	OISC	1	4000 x 110/220
1	200	GE	Auto	3/2	4150 x 2400
1	150	GE	KS	1	2300 x 230
1	100	Pitts.		1	2750 x 110/220
3	100	Wagner	RCKV	1	240 x 120/120
2	100	Whse.	SK	1	4400 x 220/440 Taps
2	100	Newark	Dry	3/2	440 x 220
3	100	GE Pyrn.	H	1	4160 x 220/440
3	100	GE	Auto	1	4150 x 2300
1	100	Amer.	OC	1	15000 x 2300
3	75	GE	H	1	2400 x 220/440
3	75	Whse.	SK	1	2400 x 440
7	50	Whse.	SK	1	13750 x 125/250
11	50	GE	H	1	13750 x 125/216
5	50	Whse. Insert.	S	1	4160 x 120/240
2	37½	GE	H	1	2400 x 120/240
2	37½	AC Dry	AD	1	450 x 120
1	37½	Amer.	RS	1	13800 x 220/440
1	37½	GE	H	1	13800 x 230/460
1	37½	Amer.	OISCID	1	13200 x 230/440
3	37½	GE	Dry	1	440 x 220/110
12	25	Whse.	Dry	1	440 x 220/110
1	25	Maloney	Oil	1	230/460 220/110

A.C. GENERATORS
3 Phase, 60 Cycle

Qu.	KVA	MAKE	TYPE	VOLTS	SPEED
1	3500	Whse.		2300	720
1	625	GE	ATB	600	3600
1	375	AC		480	450
1	300	GE	ATB	600	600
1	200	AC		240	3600
1	200	Whse.		240	600
1	225	Whse.		550	514
1	125	GE	ATB	240	600
1	170	Whse.		2300	900
2	50	Whse.		220/440	900
3	44	Columbia		240	1200
1	31	Amer.		120/208	1200
1	18.75	Star		220/440	1800
1	12.5	Whse.		240	1200

D.C. MOTORS

Qu.	HP	MAKE	TYPE	VOLTS	SPEED
1	125	GE	BC	230	1700
1	100	GE	LC	230	525
1	80	GE	CDM	230	1750

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

Qu.	KW	MAKE	SPEED	DC	AC
1	1000	GE	514	600	2300/4150 Syn.
1	500	GE	900	275	2300/4150 Syn.
1	400	GE	900	275	2300/4150 Syn.
1	300	GE	1200	250	2300 Syn.
2	150	GE	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	2300 SC
1	100	CW	1200	125	230/440 SC
1	100	El.Mach.	1200	125	4150 Syn.
2	75	GE	1200	125	220/440 SC
6	75	GE	1200	60	220/440 SC
1	50	Ridgeway	1200	550	220/440 SC
1	50	Whse.	900	250	220/440 SC
2	40	El.Mach.	1750	125	440 SC
1	35	Ideal	1200	125	230/440 SC

OIL CIRCUIT BREAKERS

1—3000	A GE	15000V	3 pole	FK	150
1—3000	A GE	4500V	3 pole	FK	12
2—3000	A GE	600V	3 pole	K	25
1— 600	A Condit	15000V		DR	100
1— 400	A Whse.	37000V		O	221

FLEX ARC WELDER
2—500 Amp. Whse. AC Welder

SPECIAL
1—120 KW 150 KVA Ames Uniflow 16 x 16 220V, 3 ph, Non-Condensing.

NEW CONTROL
4—150 HP GE CR 7051 Sq. Cage Automatic 440V, 3 ph.

Welding Motor Generator Set
1—175 KVA 2202 .87 PF single phase with exciter and 75 HP motor and controls.

LARGE STOCK OF D.C. MOTORS AND GENERATORS, SWITCHBOARD AND CONTROL EQUIPMENT

A.C. MOTORS
3 Phase, 60 Cycle
Synchronous

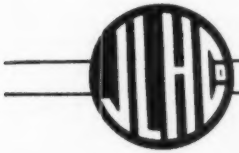
Qu.	HP	MAKE	TYPE	VOLTS	SPEED
4	300/100	Whse.		4150	720/360
1	300	El.Mach.		2300	360
1	300	GE	TS	440	257
1	185	GE	ATI	2300	720
1	150	GE	TS	220	1800
2	150	AC		2300	360
1	100	GE	ATI	2300	900
1	70	El.Mach.		2300	180
1	35	GE	ATI	2300	1200
1	20	Whse.		220	1800

SLIP RING

Qu.	HP	MAKE	TYPE	VOLTS	SPEED
1	2500	GE	MT	6600	257
1	500	GE	MT	2200	720
1	300	Whse.	CW	440	600
1	250	Whse.	CW	440	600
1	200	Whse.	CW	440	900
1	150	GE	IM	440	450
1	100	GE	IM	440	600
1	75	GE	MT	220	1200 Vert.
1	75	GE	MT	440	900
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1720
1	50	GE	MT	220	1200
1	50	Whse.	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	600
1	40	GE	MT	220	1200
1	40	GE	MT	2200	1200

SQUIRREL CAGE

Qu.	HP	MAKE	TYPE	VOLTS	SPEED
1	150	CW		2200	1200
1	125	GE	KF	2300	1800
1	125	US		440	1200 Vert.
1	100	LA	RY	440	1800
1	100	Whse.	CS	440	1800
1	75	GE	KF	220/440	1200
1	75	Ideal	AT	220/440	1200
1	60	Whse.	CS	2300	900 Vert.
1	40	GE	KT	220	1200
1	40	Whse.	CS	220	900
1	40/3	Whse.	CS	440	575/435
1	35	Whse.	CS	2300	1200
1	35	GE	TK	550	600
1	30	GE	KT	220	600
1	25	GE	KT	220	1145
1	25	GE	KT	440	1200



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"FOR POWER"

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1604 53rd STREET, NORTH BERGEN, N. J.

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PHONE NEW JERSEY — UNION 3-2600

WAGNER
CERTIFIED REBUILT

ELECTRIC MOTORS & GENERATORS
Backed by 44 Years of Quality & Service

M-G SETS

KW	Mfr	Input V	Output V
500	G.E.*	2300/4000 AC	600 DC
300	Allis Ch.*	220/440 AC	250 DC
300	Gen. Elec.	440/35 cy.	275 DC
300	Whse.*	2300/4000 AC	600 DC
200	G.E. b.b.	220/440 AC	250 DC
200	Ridgeway*	2300/4000 AC	550 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Reliance*	220/440 AC	250 DC
150	Gen. Elec.	220/440 AC	125/250 DC
150	Burke*	220/440 AC	250 AC
105	Century b.b.	220/440 AC	70 DC
100	Allis Ch.	220/440 AC	125/250 DC
100	Allis Ch.	2200 AC	250 DC
75	Gen. Elec. (3)	220/440 AC	125 DC
75	Cr. Wh. b.b. (2)	220/440 AC	250 DC
75	Star* b.b. NEW	220/440 AC	50 DC
58	Whse.	220/440 AC	250 DC
50	Gen. Elec. (2)	220/440 AC	125 DC

*Sync. motor drive.

D. C. MOTORS

HP	Mfr	Type	Volts	Speed
200	Reliance	1970T	230	575/750
150	Cr. Wheeler b.b.	52H	230	1200
150	Cr. Wheeler b.b.	TEFC	230	800
140	Whse.	SK181	230	450/900
100	Gen. Elec.	G	230	575/1000
100	Gen. Elec.	BC36	115	1150
75	Allis Ch.	B-149	230	500
75	Norther's	K36	230	1750
75	Cr. Wh. NEW b.b.	CMC-HH	230	1150
75	Century NEW	DN	230	850
75	Whse.	SK181	230	300/1200
60	Century NEW	DN	230	1150
60	Century NEW	DN	230	1750
50	Cr. Wheeler	FH	230	1750
50	Cr. Wh. b.b.	101H	230	300/1200
40/60	Whse. (2)	SK160	230	500/1000
40	Cr. Wheeler	EH	230	1750
40	Century (2) NEW	DN	230	1150
40	Whse. (2)	SK130	230	950
35/50	Gen. Elec.	CD123	230	575/1150
30	Reliance b.b. (3)	230T	230	850
30	Whse.	SK93	230	1750

- EXPLOSION PROOF MOTORS—
- GEARHEAD MOTORS, AC & DC.
- FREQUENCY CHANGERS.
- CIRCUIT BREAKERS, AC & DC.

D. C. GENERATORS

HP	Mfr	Type	Volts	Speed
300	Gen. Elec. 1 brg.	DMC	275	720
200	Reliance	1970T	250	720
150	Cr. Wheeler b.b	TEFC	250	1200
125	Cr. Wheeler b.b.	52H	250	1200
105	Century b.b.	1500 amp.	70	1200
100	Gen. Elec.	C	250	750
100	Allis Ch. 3 wire	MCW	120/240	1200
100	Gen. Elec.	DLC	125/250	675
75	Cr. Wh. NEW b.b.	HH	250	1150
75	Allis Ch.	E	250	750
75	Gen. Elec. (2)	RC36	125	1200
65	Whse.	SS	250	1100
50	Whse.	SK	250	1200
25	G.E. b.b.	CDM	25	1200

A. C. MOTORS—25 CYCLE

HP	Mfr	Type	Volts	Speed
300	Gen. Elec.	I-M	440	750
150	Whse.	HF	440	500
150	Gen. Elec.	IK-16	440	750
100	Gen. Elec.	I-K	440	500
50	Gen. Elec. Int.	MTC5337	440	750
50	Gen. Elec.	I-K	440	750
50	Gen. Elec.	KT2339	440	1500
40	Gen Elec.	KT2343	440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
375	Gen. Elec.	ATB7567	240/480	1200
300	Gen. Elec.	ATB	600	720
250	Whse.	G	2400/480	600
225	Gen. Elec.	ATB	240/480	600
187	Gen. Elec. (2)	ATB	240/480	900
156	Elec. Machy.	2 brg.	240/480	514
125	Gen. Elec.	ATB	240/480	720
125	Gen. Elec.	ATB	240/480	300
100	Gen. Elec.	ATB	2300	900

A. C. MOTORS—SLIP RING
3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	500	G.E. 3 brg.	I-M	450
1—	400	Gen. Elec. 2300V.	IM-EB	1800
2—	300	Allis Ch. 2300V.	ANY	720
1—	300	Gen. Elec. 2200V.	I-M	1800
1—	300	G.E. b.b. New	M566	900
1—	250	Allis Ch. 2200V.	ANY	514
1—	200	GE. 2200V.	I-M 17A	450
2—	200	Gen. Elec. 2200V.	I-M-16	600
1—	200	Gen. Elec.	I-M	360
1—	200	Allis Ch. 2200V.	ANY	720
2—	150	Gen. Elec. 2200V.	I-M-16	600
1—	150	G.E. 2200/4000V.	I-M	1200
1—	150	Allis Ch.	ANY	600
1—	150	Gen. Elec.	I-M-17	450
1—	125	Gen. Elec.	IM-15	720
1—	100	Gen. Elec.	MT356	900
1—	100	Gen. Elec.	I-M	720
1—	75	Howell	SR443	1800
1—	75	Cont. b.b. NEW	SN584	1200
1—	75	Gen. Elec.	I-M-813	1200
2—	75	Gen. Elec.	I-M-14	720
1—	75	Gen. Elec. Int. duty	MTC5342	900
1—	75	Gen. Elec.	MT558	600
1—	75	G.E. 2200V.	MT556	720
1—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Gen. Elec. Int.	ITC5013	600
1—	50	Gen. Elec.	I-M	720
1—	40	Gen. Elec. Int.	MTC5526	900
2—	40	Gen. Elec.	MT336	1200

A. C. MOTORS—SYNCHRONOUS

HP	Mfr	Type	Volts	Speed
600	Gen. Elec. (2)	TS	2200	514
400	Gen. Elec. .8PF	TS	220/440	1200
300	Whse.	G	2200/440	600
300	Gen. Elec.	ATI	4160	720
300	Whse.	.8PF late	440	450
275	Gen. Elec. (2)	ATI	2200	450
220	G.E. 3 brg. .8PF	ATI	220/440	600
200	GE. 8PF	ATI	220/440	900
190	El. Machy.	3 brg	220/440	514
175	Gen. Elec. (2)	ATI	2300	450
150	Gen. Elec.	ATI	220/440	300
150	Gen. Elec. (2)	ATI	220/440	720
125	Gen. Elec.	TS	2300	900
100	American b.b.	YGH	220/440	900
75	Whse.	.8PF late	220/440	1200

A. C. MOTORS—SQUIRREL CAGE
3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
1—	400	Whse. 2200V.	CB	1800
1—	325	Gen Elec.	KT420	400
1—	250	Gen. Elec.	FT549AZ	3600
1—	250	Gen. Elec.	FT549	3600
1—	250	Whse.	CS854A	720
1—	200	Whse. b.b. NEW	CS875	1800
1—	125	Gen. Elec. 2200V.	I-K	900
1—	150	Gen. Elec. TEFC b.b.	K4338S	1200
1—	150	Gen. Elec.	I-K-16	600
1—	150	Reliance b.b. NEW	B6085	1200
2—	150	Gen. Elec.	KF857	1200
1—	150	Gen. Elec. TEFC b.b.	K4335	720
1—	150	Gen. Elec.	IK-E13A	1800
1—	150	Gen. Elec. 2200V.	K5058	1800
1—	125	Reliance b.b. NEW	C8045	1200
1—	125	Allis Ch. 2200V.	AN	1200
1—	125	Gen. Elec.	I-K-16	450
1—	125	Cont. 2200V. b.b.	SC	1800
2—	125	Rel. TEFC NEW	B6085	1800
2—	125	F.M. 2200V. vertical	UH-16D	1200
1—	100	Allis Ch.	AR226D	900
1—	100	Allis Ch. 2200V.	AR226	1200
1—	100	Reliance b.b. NEW	C5085	900
1—	100	Rel. TEFC NEW	C5085	1200
1—	100	Gen. Elec. b.b. NEW	K5048	1800
1—	100	Cont. TEFC	NP683	1200
1—	75	Allis Ch. b.b.	ARW445	1200
1—	75	Lima b.b.	RS505	1200
2—	75	Gen. Elec.	I-K	600
1—	75	Reliance b.b. NEW	C8044	900
1—	75	Reliance TEFC NEW	C5044	1200
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen. Elec.	KT329Y	3600
2—	75	Reliance b.b. NEW	C506	1200
1—	60	Gen. Elec.	KT352	720
2—	60	Reliance b.b. NEW	B504	1800
2—	60	Reliance TEFC NEW	C505	1200
2—	60	Reliance b.b. NEW	C504	1200
2—	60	Whse. E.T.	CS804	1800
1—	60	Wagner b.b.	RP444	3600
1—	50	Allis Ch. b.b.	ARX445	1800
1—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
1—	50	Whse. hialip	WL807	900
2—	50	Gen. Elec.	KT383	600
1—	50	Allis Ch. 2200V.	AR445	1800

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3—400 KW Fairbanks-Morse Model 33-D-14 550 HP 500 RPM
5—1000 KW Fairbanks-Morse Model 38D-8⅛ 1600 HP 720 RPM
5—500-600 General Motors Model 12-567 1080 HP 720 RPM
Also 50-75-100-200-300 KW General-Motors
75—375 HP General-Motors Model 6046 Twin Six 2100 RPM War Tank Engines and Large Quantity New Spare parts
4—1000 DC Baldwin 240 Volts Model VO-6 448 HP 400 RPM
1—5000 KW GE Condensing Turbo Generator 3/60/2300/4160 Volts 3600 RPM
2—2000 KW Westinghouse Turbo Generators Non-Condensing 3/60/2300 Volts 3600 RPM

DIESEL ELECTRIC ENGINE CO.
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VERTICAL HYDRO-ELECTRIC UNITS

1 new 1200 KW 3 phase 60 cycle 2400 volt with Leffel turbine, governor and panel board for 28' head.
1 250 KW like new with Smith turbine and Lombard governor 3 phase 60 cycle 2400 volt for 20-22' head.
1 144 KW GE 3 phase 60 cycle 240 volts 120 RPM with Smith turbine 9-12 head.
Many horizontal units up to 750 KVA and heads of water up to 150'.

We are headquarters for good used hydro-electric units. For full particulars write

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WESTON TACHOMETER MAGNETOS

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DIESEL SETS

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G.E. New Generator 950 KW 3 phase 60 cycle 480 Volts, 600 RPM, direct connected to Fairbanks-Morse OP 10 cylinder Diesel Engine and complete with auxiliaries and controls.

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2—1000 & 2—10,000 Bbl. New Vertical
6—74,000, 55,000 & 37,500 Bbl. Vert.
8—25,000 Gal. Cap. Horizontal
50—10,000 & 3—20,000 Gal. Horizontal
6—10,000 & 12,000 & 16,000 Gal. ⅜" Shell
20—10,000 Gal. Cap. 60 lbs. Press. Test

L. M. STANHOPE, Rosemont, Penna.

POWER PLANT MACHINERY

STEAM TURBINE GENERATOR UNITS

6,250 KVA Allis Chalmers condensing, 200# steam pressure, 500° FTT, 2400/4160 volts, with surface condenser.

5,750 KVA New General Electric condensing, 600# steam pressure, 750° FTT, 2400/4160 volts, with or without new surface condenser.

5,000 KVA New General Electric non-condensing extraction, 600# steam pressure, 750° FTT, 125-150# extraction, 25-50# exhaust, 13,800 volts.

4,375 KVA General Electric condensing, 200# steam pressure, 500° FTT, 2300 volts, with surface condenser.

3,750 KVA Allis Chalmers condensing, 250# steam pressure, 550° FFT, 480 volts, with jet condenser.

3,750 KVA Westinghouse condensing, 200# steam pressure, 500° FFT, 2300 volts with surface condenser.

3,125 KVA New General Electric condensing, 600# steam pressure, 750° FTT, 2400/4160 volts, with or without new surface condenser.

3,125 KVA Westinghouse-Moore condensing extraction, 175# steam pressure, 500° FTT, 25# extraction, 2400 volts, with jet condenser.

2,500 KVA New General Electric condensing extraction, 400/600# steam pressure, 750° FTT, 100-150# extraction, 480/2400/4160 volts, with or without new surface condenser.

2,250 KVA New General Electric condensing, 400# steam pressure, 725° FTT, 2300 volts, with surface condenser.

1,875 KVA Allis Chalmers condensing, 200# steam pressure, 500° FTT, 2300 volts, with jet condenser.

1,875 KVA Westinghouse condensing, 200# steam pressure, 500° FFT, 2300 volts, with surface condenser.

1,543 KVA General Electric non-condensing, 250# steam pressure, 600° FTT, 20# exhaust, 2400 volts.

1,250 KVA Westinghouse condensing, 400# steam pressure, 750° FTT, 2400/4150 volts, with surface condenser.

1,250 KVA Westinghouse condensing extraction, 150-250# steam pressure, 600° FTT, 10# extraction, 480 volts, with surface condenser.

1,250 KVA General Electric condensing, 200# steam pressure, 500° FTT, 2300 volts, with jet condenser.

938 KVA Allis Chalmers condensing extraction, 150# steam pressure, 500° FTT, 5# extraction, 480 volts, with surface condenser.

625 KVA Westinghouse non-condensing, 150-200# steam pressure, 600° FTT, 25# exhaust, 480 volts.

625 KVA General Electric non-condensing, 400# steam pressure, 700° FTT, 50# exhaust, 2300 volts.

UNIFLOW ENGINE GENERATOR UNITS

750 KVA Allis Chalmers—Ames, vertical, 150# steam pressure, 5# exhaust, 2400/4160 volts.

625 KVA General Electric—Skinner horizontal, 150# steam pressure, 5# exhaust, 240 volts.

500 KVA General Electric—Skinner horizontal, 150# steam pressure, 5# exhaust, 2300 volts.

375 KVA General Electric—Skinner horizontal, 150# steam pressure, 5# exhaust, 240/480/2400/4160 volts.

312 KVA General Electric—Skinner horizontal, 125# steam pressure, 5# exhaust, 480 volts.

250 KVA General Electric — Ames vertical, 150# steam pressure, 5# exhaust, 480 volts.

188 KVA Electric Machinery—Ames vertical, 150# steam pressure, 5# exhaust, 480 volts.

STEAM BOILERS

60,000 LBS. Combustion Engineering boiler, 450# steam pressure, 600° FTT, with Coxe traveling grate stoker.

50,000 LBS. Babcock & Wilcox boiler, 300# steam pressure, 530° FTT, with pulverized coal burners.

45,000 LBS. Wicks boiler, 175# steam pressure, 500° FTT, with spreader type stokers.

40,000 LBS. Babcock & Wilcox boiler, 200# steam pressure, 500° FTT, with chain grate stoker.

34,000 LBS. Babcock & Wilcox boiler, 450# steam pressure, 625° FTT, with single retort stokers.

30,000 LBS. New Combustion Engineering boiler, 450# steam pressure, 550° FTT with spreader type stoker.

10,000 LBS. Keeler boiler, 250# steam pressure, 500° FTT with spreader type stoker.

DIESEL ENGINE GENERATOR UNITS

1,250 KVA New Crocker Wheeler—General Motors, 480/2400 volts, 720 RPM.

750 KVA Crocker Wheeler—General Motors, 480/2400 volts, 720 RPM.

250 KVA Fairbanks-Morse, 480 volts, 257 RPM.

250 KVA Electric Machinery—Buckeye, 480 volts, 514 RPM.

187 KVA Electric Machinery — Buckeye, 240 volts, 400 RPM.

75 KVA General Electric — General Motors, 2400 volts, 1200 RPM.

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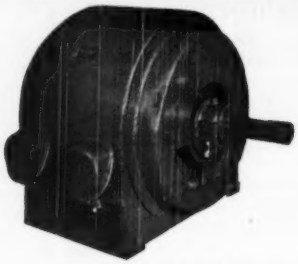
2—New 500 HP, 1200 RPM Elliott, 220/440 V., 3 Ph., 60 Cy., Shaft 4½" dia. x 8" long. (Photo right.) Control Available.



M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	250	2200	C-W
400	125/250	2300	Ideal
300	250	2200	G.E.
300	125/250	440/2300	Allis (New)
200	250	2200	Whse.
200	125/250	2200	G.E.
150	250	440	G.E.
125	250	440	Whse.
100	250	220/440	Star (New)
75	250	440	C.W
60	250	220	G.E.
50	250	440	Whse.
30	250	440	Ideal

Reconditioned and guaranteed

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
900	150	440	G.E.	80%
650	138	2300	Whse.	Engine
500	514	440	E-M	100%
400	900	2300	Whse.	80%
400	720	440	G.E.	80%
400	600	440	G.E.	100%
400	514	440	G.E.	100%
350	900	440	G.E.	100%
350	200	2300	Whse.	100%
300	514	440	G.E.	100%
250	600	4160	E-M	100%
150	900	2300	G.E.	100%
75	900	220	E-M	80%

SLIP RING — R & G.

HP	RPM	Volts	Mfg.
1000	514	4000	Whse.
800	514	2300	Whse.
700	450	2300	G.E.
700	720	2300	Allis
500	450	2300	G.E.
450	514	440	Whse.
400	720	2300	G.E.
350	450	2300	Whse.
300	600	440	G.E.
250	600	440	G.E.
200	1200	440	G.E.
150	1200	2300	G.E.
150	900	2300	C-W
150	600	440	G.E.
125	900	440	F-M
125	720	220/440	E-M
100	900	2200	A-C
50	720	220	Whse.

NEW DIRECT CURRENT

230 Volt Drip proof — ball bearing

Qu.	HP	RPM	Mfg.	Frame
3	3	690/2660	G.E.	284
12	5	850/1700	G.E.	CD-66
5	7½	575/1750	G.E.	CD-77
2	7½	575/2300	Rel.	T-46
1	10	575/2300	L.A.	4051
3	10	1750	Rel.	T-34
2	30	850/1700	Rel.	T-230
1	75	400/1200	Rel.	T-651
5	250	1750	A-C	149

Reconditioned and guaranteed

230 VOLTS D.C.

HP	RPM	Mfg.	Brg.
250	400/1200	E-D	Ball.
200	300/ 900	Whse.	Ped.
200	400/1200	Rel.	Ball.
150	350/1200	Whse.	Ped.
150/200	300/ 900	Rel.	Ball.
125	400/1200	G.E.	Sleeve
125	300/ 900	Rel.	Sleeve
100	500/1500	C-W	Ball.
100	475/1350	E-D	Sleeve
75	500/1500	C-W	Ball.
60	400/1200	Whse.	Sleeve
50	350/1050	Whse.	Ball.
40	400/1600	Rel.	Ball.

NEW SLIP RING CONTROLS

10—250 HP 440/3/60 Fully Magnetic, Reversing, 7 steps acceleration, Allis-Chalmers, with air ckt. brkr. Open or enclosed.

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BOSWICK ELECTRIC CO.

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COMPLETE WITH SWITCHBOARDS

1000 KW to 100 KW

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3—10,000# American Red Flash heating
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4— 90 HP locomotive fire box 200#
4—110 HP locomotive fire box 200#
2—150 HP locomotive fire box 150#
1—250 HP B&W water tube 170#
2—150 HP H R T 150#
1—410 HP Heine water tube 200#
1—505 HP Brise water tube 200#
1000 AC 220 Turbine Generator

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6—G.E. COM-1830 Ball Bearing 230 Volt
7—Westinghouse CK-9 230 Volt
Motors complete with brakes $400.00 each

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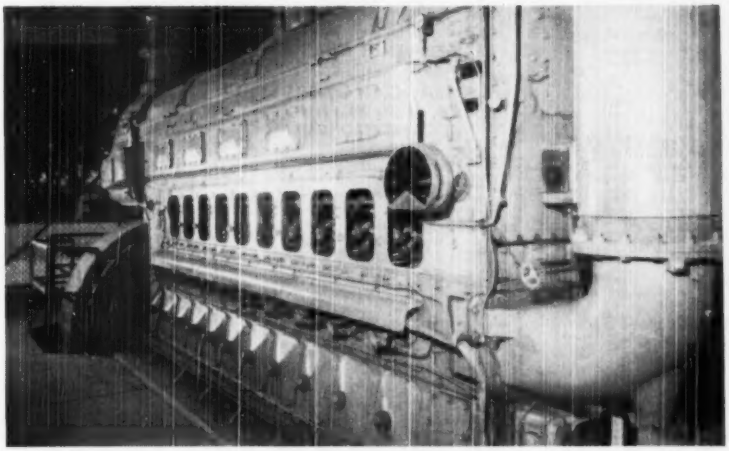
HP. @ 720-RPM.

ONE OF OUR
FAIRBANKS-MORSE OP. DIESEL ENGINE GENERATOR SETS
Installed and in Operation in the
LAMAR, COLORADO, MUNICIPAL POWER PLANT



THE ABOVE ILLUSTRATION SHOWS ONE OF OUR MUNICIPAL Installations of our Fairbanks-Morse Opposed Piston, 1600-hp., @ 720-rpm., Type 38D8 1/8, 10-cylinder Diesel Engines, Direct connected to a 3/60/2300/4160-v., AC Generator. This installation is in the Municipal Plant at Lamar, Colo., Mr. B. A. Fleshman, Superintendent. It has been in operation 12 mos., has given entire satisfaction and also shown a radical reduction in operating cost.

INVESTIGATE THE ADVANTAGES OF THESE F.-M., OPPOSED PISTON DIESELS for STATIONARY or MARINE SERVICE. Correspondence solicited. We have a Few Duplicate Sets in stock for Immediate Delivery.

A FEW OTHER DIESEL POWER UNITS IN OUR STOCK:

6—Hamiltons, 1600-HP., 720-RPM., with West. Reversing Reduction Gears: SAME AS NEW: 15—Baldwin-Westinghouse 300-KW, DC., 240-v., 400-RPM.: 4—GM. Model 3-268-A, 100-KW. 4—FM. OP., 1200-HP., 720-RPM., Engines, 8-cyl. Nearly New. AND MANY OTHERS. Write Us. Giving Specifications.

WE ALSO SPECIALIZE IN TURBO-GENERATORS AND BOILERS

PARTIAL LIST OF TURBO-GENERATORS IN OUR STOCK

6250-KVA., G.E., 2300/4160v. Cond.
4375-KVA., G.E., Rebuilt: New Coils
3125-KVA., G.E., Complete, 25~
3125-KVA., West., 25~, 2300v. Cond.
2500-KVA., West., Non-C., 25~ (2)
2500-KVA., G.E., 15~, Cond. 2300v.
1875-KVA., G.E., 250-psi, No. 1 unit
1875-KVA., Allis-C., Cond., 200~, 2300v.
1563-KVA., G.E., 200-psi, Non-C., 15/25-BP
1563-KVA., G.E., 225-psi, Cond., 2300v.
937-KVA., G.E., 150-psi, Non-C., 480v., 15-BP
937-KVA., Allis-C., Cond., 480v.
937-KVA., G.E., Cond., Rebuilt
625-KVA., West., Non-C., 300~psi, 480v., 15/25-BP
625-KVA., G.E., Cond., 200-psi, 480v.
625-KVA. (2), G.E., Non-C., 480v., 150~, 15/25-BP
625-KVA. (2), DeLaval-Allis, 125~, 480v., 15/25-BP

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Good Equipment
Immediate Deliveries
Right Prices

FROM AVAILABLE STOCK

Rebuilt to N.I.S.A. Standards

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1400	Whse.	352	700	2200
1	1800	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2300/4400
1	1250	G.E.	690	275	2300
1	1000	G.E.	720	250	2300/13200
1	1000	Whse.	900	600	2300/4150
1	1000	West.	514	250	4150
1	800	G.E.(3U)	1200	120/240	2300
1	750	Whse.	900	250	2300
1	500	G.E.	900	250	440/2300
1	500	G.E.	720	125	2300/4000
2	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	400	G.E.	720	600	9560
1	350	G.E.	900	125	2300/4150
1	300	Whse.	1200	250	1200
1	150	Cr. Wh.	1200	250	440
1	140(3U)	Cr. Wh.	690	125/250	2300
1	100	G.E.	1170	125	220
1	75	Cr. Wh.	1170	250	220/440

ROTARY CONVERTERS

60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	2000	G.E.	514	600	13800
1	2000	G.E.	450	600	2300
1	1000	Whse.	900	600	11000
1	750	Whse.	900	600	13200

RECTIFIERS

1— 750	G.E.	BHW	575	2300
1—1000	A.C.	B-612	625	13500
1—1000*	A.B.B.	HRZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	1000	G.E.	Condensing 135/150# ISP 2300/4150 V 3 ph. 60 cy.
2	750	G.E.	Condensing 250/275# ISP 440V. 3 ph. 60 cy. (New 1944)
1	500	Al. Ch.	Non-condensing 125/150# ISP, 5/20# B.P. 480V. 3 ph. 60 cy. with exciter.
1	450	Worth	Condensing 250# ISP geared to 1200 RPM. 440V. 3 ph., 60 cy. gen. with exciter.
2	400	G.E.	Condensing. 275# ISP Geared to 1200 RPM. 120/240V. D.C. Generator.
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM 120/240V. D. C.
	200	Cr. Wh.	Condensing 250# ISP GEARED to 1200 RPM—125V. D.C. Gen.
1	200	Whse.	Non-condensing 150# ISP 7# B.P. 240V. 3 ph. 60 cy.

TRANSFORMERS

60 Cycles

Qu.	KVA.	Make	Type	Ph.	Voltages
1	2500	Packard	AT	3	13800 x 2300
1	2500	Al. Ch.	OISC	3	13200 x 2300
3	1000	Pitts.	OISC	1	13200 x 2300
3	125	G.E.	H	1	6600 x 500
1	1000	G.E.	WCTH	3	11000 x 445
3	667	Al. Ch.	OISC	1	13200 x 230/460
1	600	Al. Ch.	OISC	3	4000/2300 x 216
3	333	Maloney	C	1	7620/13200x120/240
3	333	Pitts.	OISC	1	66000 x 2300
6	250	Whse.	OISC	1	11000 x 240
3	200	Whse.	OISC	1	7200 x 240/480

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—2100	Whse.	REV	700	50/125
1—1750	Whse.		600	525/720
1—1500	Whse.		525	600
1—1200	Whse.		600	425
1—940	Whse.	QM-R.Brg.	250	140/170
1—800/1000	Whse.		450	600/720
1—650	G.E.	MPC	250	115/145
1—600	Al. Ch.	MILL	250	600/900
1—300/400	G.E.	DYNA	250	1325/2500
1—335	Whse.	MQ	250	380/900
1—200/300	G.E.	MPC	230	360/920
1—275	Whse.	QM-600-8	230	425/850
1—250	G.E.	MPC	230	400/500
1—150	G.E.		600	250/750
10—150	Cr. Wh.	83H	230	890

FREQUENCY CHANGERS

1—2000	G.E.	25/60 Cycle	2300/2300V
1—500	A.C.	25/60 Cycle	11000/2300V

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	TS	2300	257
1—2100	G.E.	ATI	4600	514
2—2000	Whse.		2300	120
1—1470	Whse.		4600	900
1—1000	Whse.		2300	180½
2— 900	Al. Ch.	(New)	2200	150
1— 650	Whse.	G	2200	138
1— 600	Whse.	Syn.	440	360
1— 450	Whse.	Eng.	2200	128.5
2— 350	G.E.	TS	2200	150
1— 320	G.E.	ATI	2300	600
1— 300	G.E.	ATI	440	720
1— 300	Whse.		2300	720
1— 300	Al. Ch.		440	600
1— 225	G.E.	ATI 1-Brg.	440	900
1— 125	G.E.	ATI	440	450
1— 100	E.M.	Unused	440	600
1— 100	Whse.		550	600

SLIP RING

2— 700	Whse.	CW	2300	900
1— 500	G.E.	IP	550	505
1— 500	G.E.	IM-Mill	2200	450
2— 350	Whse.	CW	2200	900
1— 350	G.E.	MT-442Y	2200/4000	253
1— 300	Al. Ch.	3 Brg.	2300	505
1— 300	G.E.	IM	440	720
9— 300	Al. Ch.	ANY	2200	708
1— 250	G.E.	M-567-TEFC	440	600
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2200	1750
4— 125	G.E.	MT-566Y	440/2200	435
4— 100	G.E.	MT-566Y	440/2200	425
2— 100	G.E.	IM-16	2200	435
2— 100	G.E.	IM	440	600
3— 100	Al. Ch.	AK	2200	1200

SQUIRREL CAGE

2— 450	Whse.	CS	2300/4150	354
1— 200	G.E.	IK	550	865
1— 200	G.E.	KT-557	440	1800
1— 200/112	G.E.	KP-559BS	440	1170/885
1— 125	Whse.	MS	440	485
1— 125	(New) G.E.	KP-TEFC	440	1190
1— 125	G.E.	KP-TEFC	440	3585
3— 125	Al. Ch.	ARW	2200	1750
1— 100	Al. Ch.	AR	2200	1170
1— 100	G.E.	IK-Vert.	2300	450
2— 100	G.E.	KT-543	220/440	1750
3— 75	G.E.	KT-547Y	2200	1160

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse.		4800	720

RE NU BILT BELYEA MOTORS

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

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POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

2—New 4000 KW 4160 V. 600#
1—3500 KW 550 V. 200# Cd.
1—2500 KW 550 V. 250# Cd.
2—1800 KW 2500 V. 400# Cd.
2—1000 KW 2300 V. 200# Cd.
2—1000 KW 480 V. 180# Cd.
1— 750 KW 240 V. 150# Cd.
1— 750 KW 550 V. 170# EX.
1— 750 KW 2300 V. Ext.
1— 500 KW 2300 V. Ext.
1— 500 KW 550 V. Cd.
1—1500 KW 125/250 V. Cd.
1— 465 HP Turbine 800#

BOILERS

2—50,000# 300#
1—30,000# 400#
1—680 HP—200#
2—500 HP—400#
1—487 HP—200#
2—250 HP—425#
2—220 HP—100#
1—72" HRT 150#

DEAERATING HEATERS

3—90,000# Pr. Hr.

ENGINE GENERATORS

1—300 KW 2300 V. Unit.
1—375 KW 2300 V. Unit.
1—168 KW 220 V. Unit.

DIESEL GENERATORS

2—800 KW—2300 V.
2—200 KW—480 V.

COMPRESSORS

33,330 CFM—Cent. 7#
4900 CFM—Gas 50#
1700 CFM—100#
500 CFM—Diesel (2)

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

THE BUYERS MUST BE SATISFIED—ALWAYS

DIESEL GENERATOR SET!

225 HP Busch Sulzer Model DF, 3 cyl., 4 cycle, solid injection, 360 RPM. Direct erator with direct connected exciter, air connected 150 KW 3/60/2300 volt genfilter, muffler, etc. A modern unit in perfect condition only $4000 f.o.b. St. Louis.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

FOR SALE

DELAVAL TURBINE GENERATOR SET

Steam 125 pounds, Exhaust O, 75 KW, Crocker Wheeler, Type CCD, 250 Volts, direct current, compound interpole, 1200 RPM Generator, gear reducer and base.

ELECTRIC APPARATUS REPAIR COMPANY
1400 No. 6th St. Phila. 22, Pa.

The Stephen A. Douglass Co.

have condensing type

TURBO-GENERATORS

in complete units,

Capacities 500 KW to 10,000 KW

CAPITAL COST LOW

Current cost per KW LOW

? *On What Capacity Unit Shall We Quote You* ?

Can Supply Boilers Also.

630 Fort Washington Ave., N. Y. 33, N. Y.

SELLING FOR CUSTOMERS

1500 KW 4000 V Allis Chalmers Cond turbine 200 lb. 5 lb. B.P.
300 KW 240 V Westinghouse geared Nonsond. turbine
400 KW 480 V 1200 RPM Elliott generator with 1200/4500 gear
285 KVA 240 V Chase inlfow engine set.
2000 Amp. 3-pole GE Air breaker with Bus Duct.
300 & 200 KW Syn M.G. Set with control.

H. BLANE JOHNSON & ASSOCIATES
53 W. JACKSON BLVD., CHICAGO 4, ILL.

Holly Gravity Return System

Steam Boilers and Accessories

RUSSELL B. HOBSON and SONS
GREAT NOTCH NEW JERSEY

1—500 KW, Westinghouse, 1200 RPM, 3 Phase, 60 Cycle, 480 Volt AC Generator Direct Connected Through Worthington Gear to a Worthington-Moore Turbine, 275 Pounds; Bleeder Pressure, 10 Pounds; Exhaust, 1 Pound, Abs.

The generator panel is complete with 1000 amp. air circuit breaker, the usual instruments, voltage regulator, etc. There is also, with the unit, a Wheeler surface condenser with motor-driven circulating pump and condenser removal pump.

This equipment is located in Oakland, California and has never been used. It can be purchased at a bargain. Please address your inquiries to:

ALBERS MILLING COMPANY
5045 WILSHIRE BLVD.
LOS ANGELES 36, CALIFORNIA
Attn: W. G. Fisher

POWER EQUIPMENT—READY TO SHIP

A.C. MOTORS—3 PH. 60 CY.

No.	HP.	Make	Type	Speed	Volts
1 NEW	290	West.	SYN	1200	220/440
1	250	Burke	SYN	720	2200
1 vert	250	G.E.	I	1175	2200
1	200	G.E.	I	865	2200
1	200	G.E.	SYN	1800	2200/550
1	175	West.	MS	1200	220/440
1	150	West.	SYN	257	220/440
1	150	West.	SYN	600	220/440
1	150	West.	SYN	900	2300
1	150	G.E.	I-K	1200	2200/220/440
1	150	West.	MS	1200	220/440
3	150	Louis Allis	FX	1750	220/440
4 NEW	125	West.	SYN	1200	220/440
1	125	G.E.	I-K	900	220/440
1	125	Elec. Mach.	SYN	164	220/440
1	112	West.	SYN	1200	220/440
1	100	Reliance	IT	495	220/440
1	100	Al. Chal.		720	220/440
1	100	G.E.	I-K	900	220/440
1	100	G.E.	I-K	900	2200
1	100	West.	SYN	900	220/440
1	100	Cr. Wh.	SC	1100	2200/220/440
1	75	Elec. Mach.	SYN	900	220/440
1	75	Master	PA	1750	220/440
1 NEW	75	Al. Chal.	AR	865	220/440
1	75	Al. Chal.		580	220/440
1	75	West.	CS-877C	600	220/440
1	75	G.E.	I-K	600	220/440
1	75	G.E.	I-K	720	2200
1	75	G.E.	I	720	220/440
1	75	Louis Allis	OGS	1200	220/440
1	75	Burke		1200	220/440
1	75	Louis Allis	FAA-502Y	1150	220/440
2	75	West.	CS (TEFC)	1750	220/440
1	60	G.E.	KT-533	1800	550
1	60	Burke	—	900	220/440
1 NEW	60	Reliance	TEFC	880	2200/550
1	60	Al. Chal.		515	220/440
1	60	G.E.	I-K	600	220/440
1	60	Cr. Wh.	SC	720	220/440
5 NEW	60	West. (EXPLOSION	CS-607 PROOF—TEFC)	900	220/440
1	60	Elec. Dyn.	drip pr.	3600	4000/2200
1 NEW	50	West.	TEFC	1765	220/440
1	50	Wagner	TEFC	1750	220/440
1	50	West.	CS	1750	220/440
1	50	G.E.	KP	860	220/440
1 NEW	50	Reliance	C	720	220/440
2	50	G.E.	KT-548	720	220/440
2 NEW	50	Reliance (TEFC)	B-504-8	1750	2200
3 NEW	50	G.E. (TEFC)	K-504	1750	2200
1 NEW	30	West.	CS-445 hi-torq	900	220/440

230 V. D.C. VARIABLE SPEED MOTORS

HP	Make	Type	RPM
75	Westg.	SK-181	300/1200
75	Allis Chal.		400/1200
50	Westg.	SK-191	250/1050
40	Elec. Gen.		385/1200

SPECIAL BARGAINS
Diesel Engine Generator Sets

10—100 kw., 120/240 v. D.C. Delco Generators dir. con. to 150 HP Model GBD-8, 8½x7, 8 cyl. Superior DIESEL Engines, elec. start with engine panels.
4—100 KW same as above with 220 or 440 v. NEW A.C. Generators
1—63 kva. 120/208 v. 3 ph. 60 cy. 1800 rpm., driven by Cat. DIESEL m't'd on trailer
1—90 kva. Fairbanks Morse 220/440 v. 3 ph. 60 cy. 360 rpm DIESEL
1—75 KW 220/440 v. 3 ph. 60 cy. International GASOLINE
2—75 kva. 220/440 v. 3 ph. 60 cy. Delco Cummins. DIESEL
1—62 kva. Fairbanks Morse 220/440 v. 3 ph. 60 cy. 1200 rpm DIESEL
2—37½ kva., 220/440 v. 3 ph. 60 cy. Buda DIESEL
10—NEW 37½ kva., 220/440 v. 3 ph. 60 cy. LeRoi Gasoline
1—31.3 kva. 120/208 v. 3 ph. 60 cy. G.E. Gen. driven by LeRoi GASOLINE
11—NEW 25 kva. 120/220 v. 1 ph. 60 cy. LeRoi GASOLINE
3—25 KW BRAND NEW Onan 220/440 v. 3 ph. 60 cy. 1800 rpm GASOLINE
1—12½ kva. 120/240 v. 1 ph. 60 cy. 1200 rpm., dir. con. Hercules GASOLINE
2—12 kva. 120/240 v. 1 ph. 60 cy. LeRoi GASOLINE
2—7½ kw. 120/208 3 ph. 60 cy. Buda GAS.

230 V. SERIES WOUND MOTORS

HP	Make	Type	RPM
15	G. E.	CO-1807	800
11	Westg.	K-5	470/630
40	Westg.	K-9	700

SLIP RING MOTORS—3 ph. 60 cy.

HP	Make	Rpm	Volts
600	Ideal	1770	220/440
500	Ideal	1770	220/440
400	Ideal	1770	220/440
250	Crocker Wh.	690	220/440
75	G.E.	450	220/440
60	G.E.	570	220/440

A. C. GENERATORS—3 ph. 60 cy.

No.	Kva	Make	Rpm	Volts
6 NEW	100	West.	1200	220/440
10 NEW	37½	West.	900	220/440
3	25	Onan	1800	220/440
11 NEW	25	West. (1 ph.)	900	220/440

GEAR MOTOR BARGAIN

50 HP G. E. 1735 rpm input 13 rpm output speed 220/440 or 550 v. A.C. 3 ph. 60 cy. splash proof ball bearing.

MOTOR GENERATOR SETS—250 V. D.C.
Motors 220/440 volt or 2200 volt

No.	KW	Make	Rpm
2	200	Westinghouse	1200
1	150	Westinghouse	700
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	580
1	100	Delco	1200

125 V. DC M.G. Sets

1—100 kw. G.E. 125 v. 950 rpm. 220/440 v. 3 ph. 60 cy. AC Syn.
1—75 kw. West. 125 v. 1200 rpm. 220/440 v. 3 ph. 60 cy. Syn.

TRANSFORMERS—1 ph. 60 cy.

No.	Kva	Make	Prl.	Sec.
1	500	Standard	2300	575/460/345 230/115
3	300	G.E.	2300	230/460
8	333	Maloney	2300	230/460
3	200	G.E.	2300/4600	230/460
3	150	West.	2400/4160	240/480
3	150	Pah.	2300	230/460
1	100	Peerless	2300	230/460

NEW DIESEL ENGINES

3—HERCULES, 6 cyl. with power takeoff, max. 135 hp. @ 2600 rpm min. 69 HP @ 1200 rpm.

NEW AXIAL FLOW VENTILATING FANS

30—6000 cfm Sturtevant Bulletin 512309 3" stat. pres. 7 blade dir. con. 5/1.5 HP 1745/1175 rpm 220/440 v. 3 ph. 60 cy. Westg. TEFC Motors.
5—5000 cfm 2.3" stat. pres. Sturtevant with 2 speed 220/440 v. 3 ph. 60 cy. Motors
2—10,000 cfm LADEL dir. con. 2 speed 220/440 v. 3 ph. 60 cy. Motors
1—12000 cfm 5" stat. pres. with 2 speed 220/440 v. 2 phase 60 cy. Motors
2—16000 cfm 3" stat. pres. Buffalo Forge with 2 speed 220/440 v. 3 ph. 60 cy. Motors
1—67000 to 98000 cfm 1" to 0.2" stat. pres. Size 50" dia. 72½" l., 2 sets propellers International Eng. Co. driven by 100 HP AC Motor

SQUARE D SWITCH

1200 amp. 230 v. A.C. fusible switch Cat. H-9418 consisting of 2—600 A. fuses in parallel.

1000 KW M.G. SET

1000 KW 600 v. D.C. 514 rpm Westg. 2300/3-60 cy. A.C.

PLATING SETS

1—1000 amp. 25 v. G. E. driven by 40 HP 220 v. D.C. 1200 rpm mtr. (Like New).
1—50 KW. Chandeyson 20/40 v. sh. wd. dir. con. 75 HP 220/440 v. 3 ph. 60 cy. syn. motor.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

MOTOR GENERATORS

1—500 KW G.E. Syn. 250 V. 900 RPM
1—400 KW WEST. Syn. 600 V. 720 RPM
2—300 KW G.E. Syn. 250 V. 1200 RPM
1—300 KW G.E. Syn. 600 V. 1200 RPM
1—200 KW G.E. Syn. 250 V. 1200 RPM
1—200 KW G.E. Syn. 600 V. 1200 RPM
1—150 KW G.E. Syn. 250 V. 1200 RPM
1—100 KW G.E. Ind. 250 V. 1200 RPM

ROTARY CONVERTERS

1—500 KW G.E. Syn. 250 V. HCC 1200 RPM
1—300 KW G.E. Syn. 600 V. HCC 1200 RPM

ARMATURES

1—500 KW G.E. 250 V. MPC Gen. 900 RPM
1—300 KW G.E. 600 V. HCC Conv. 1200 RPM

AIR COMPRESSORS

2—4200' I-R type PRE-2, Size 35x20½x24 Direct Connected to 700 H.P. G.E. Syn. TS Motor 440/2300/4000 V.

WALLACE E. KIRK COMPANY

502 Grant Bldg., Pittsburgh 19, Pa.

FOR SALE

AC-DIESEL ENGINE-GENERATORS

PRACTICALLY NEW

100 KW 3/60/460 WORTHINGTON DIESEL MODEL BB5
Price $5,000.00 each, f.o.b. Trenton

150 KW 3/60/460 BUCKEYE DIESEL MODEL 80
Price $6,500.00 each, f.o.b. Trenton

All with Westinghouse Generators, *Complete* with Exciters, Cooling Systems, Starting Equipment, Switchboard, Silencers, etc.

Subject to Prior Sale

EASTERN SCRAP & SALVAGE CORP.

65 MUIRHEID AVENUE **TRENTON 7, N. J.**

MODERN AIR COMPRESSORS

6040 Ft. INGERSOLL RAND 60 LB. ELECTRIC.
3—3866 Ft. NEW CHICAGO PNEU. OCE, ELEC. 125 LB. WITH MOTOR TO SUIT.
3178 Ft. SULLIVAN WN4 ELECTRIC. 125 LB.
1578 Ft. CHGO. PNEU. DIESEL. 125 LB.
1302 Ft. INGERSOLL RAND PRE-2 ELECTRIC. 100 LB.
810 Ft. WORTHINGTON V BELT DRIVE. 125 LB. WITH OR WITHOUT MOTOR.

DARIEN, 60 E. 42nd St., New York 17, N.Y.

Fitzgibbons RP-107 Firebox Type Boiler 107 H.P. Hand Fired Rating—Constructed in 1939

Price .....$1,500.00 F.O.B. cars

Subject to Inspection. In Excellent Shape. Available with Oil Burning Equipment.

INDUSTRIAL EQUIPMENT COMPANY

P. O. Box 673—Telephone 6750 **ORLANDO, FLORIDA**

A COMPLETE STOCK OF... ELECTRIC POWER EQUIPMENT

GET A-1 PERFORMANCE—SAVE 40 TO 70% IN PRICE

SQUIRREL CAGE MOTORS

3 phase, 60 cycle—220 or 440 volt (*2200 volt or higher)

H.P.	Make	Type	Speed
750	G.E.	KT	720
500	G.E.	KTP-367	1200
400	*Al. Ch.	ANW	900
300	G.E.	FT-558A	1800
250	Westg.	CS-956A	600
200	Reliance	AA-C60838	1200
200	*G.E.	IE-15-K	1200
150	Westg.	CS-771	1800
150	G.E.	IE-13AK	1800
150	G.E.	IE-13B	1200
150	G.E.	I-15-S	900
150	Westg.	CS-956A	600
125	G.E. TEFC	K-6326S	1200
100	U.S.-Vert.	CFU-904-A	1200
100	Burke	EW-12-5	1200
100	G.E.	K-6333	720
75	Westg. Now	CS-585-S	1800
75	Westg.	CS-761	1800
75	G.E.	FTR-543-S	1200
75	G.E.	KT-347	1200
75	G.E.	K-505	1200
75	*G.E. Vert.	CS	900
75	*G.E.	I-10-K	720
75	G.E.	FT-558	720
75	Al. Ch.	AN	720
75	*Triumph	TR-16	514
60	G.E. NEW	K-44S	1800
60	G.E. NEW	K-504	1200
60	G.E. NEW	K-504U	1200
60	Al. Ch.	AR-826F	514
60	Al. Ch.	AR-445	1800
50	G.E.	KF-4052	3600
50	G.E.	KT-327	1800
50	Westg.	CS-640	1800
50	G.E. TEFC	K-444	1800
50	G.E.	KT-343	1200
50	Burke	EM-7	900
50	G.E.	KT-346	900
50	G.E.	IK-13	900
40	*Al. Ch.	ARX-405	3600
40	G.E.	KF-4048	3600
40	Westg.	CS-640	1800
40	G.E.	KT-332	1200
40	Al. Ch.	AR-504	900
40	G.E.	KT-338	900
40	G.E.	KT-342	720
30	Howell	HBB-328	3600
30	Westg.	CS-405	1800
30	G.E.	K-444	1200
30	Al. Ch.	AR-204	900
25	Cr. Wh.	118Q	1200
25	Westg.	CS-356A	1200
25	G.E.	KT-332	900
25	Al. Ch	AR-220C	900
20	Westg.	CS-364	1800
20	G.E.	KT-301S	1800
20	Louis Allis	XL-835	1200
20	G.E.	KT-312	1200
20	Westg.	CS-464-C	1200
20	Westg.	CS-644	900
20	G.E.	KT-326	900
15	Westg.	CS-326	1800
15	G.E.	KT-312	1200
15	G.E.	FRT-502	1200
15	Westg.	CS	900
15	G.E.	KT-322	900
15	G.E.	KT-332	720
10	G.E.	KT-181	3600
10	G.E.	KT-181	1800
10	Howell	SC-150	1800
10	Cr. Wh.	SC-60	1800
10	G.E.	KT-752	1200

H.P.	Make	Type	Speed
10	G.E.	KT-956	1200
10	G.E.	KT-582	900
10	G.E.	IK	720
7½	G.E.	KT-326	600
7½	G.E.	KT-994	1800
7½	Westg.	CS-2500	1800
7½	Cr. Wh.	114-Q	1200
7½	G.E.	KT-958	900
7½	Commonwealth	P-405	514
7½	G.E.	KT-526	450
5	Star	AX-45	3600
5	G.E.	K-254	1800
5	Cr. Wh.	SC-254	1800

SLIP RING MOTORS

3 phase, 60 cycle—220 or 440 volt (*2200 volt or higher)

H.P.	Make	Type	Speed
2500	*G.E.	MT	257
2000	*G.E.	MT-38	240
1250	*G.E.	M	720
1200	*G.E.	MT-26	277
800	*Westg.	CW	307
650	West.	HE	360
500	Westg.	CW	360
500	Westg.	IE	1800
400	G.E.	CW	450
300	*G.E.	IE15A-4	1800
300	G.E.	IM-17	1200
250	Westg.	CW-32B	900
250	Westg.	CW	600
200	G.E.	IM	600
150	Al. Ch.	ANY	600
100	G.E.NEW	MG332Z	900
100	G.E.NEW	MG334	720
100	Westg.	CW-856C	600
100	G.E.	IM-15A	450
75	G.E.	IM-E-4	1800
75	Westg.	CI-756A	600
75	Cr. Wh.	25Q	600
75	G.E.	IM-14	514
60	*Westg.	CW-762C	900
50	G.E.	IM-11A	1800
60	G.E.	MT-346-8	900
50	Westg.	CW-636A	1200
50	*Al. Ch.	ARY-220BS	1800
50	G.E.	IM-14	425
50	G.E.	MT-343	1200
50	G.E.NEW	M-505	1200
40	Westg.	CW-644C	900
37	G.E.TENV	HITC-5012	600
35	G.E.	IM-6	1200
35	Fr.Mrse.	UAB-JM12D	1800
30	G.E.NEW	M504-U	900
25	Westg.	CI-572A	900
30	G.E.	MT-332	1200
25	G.E.	IM-11	1200
25	Al.Ch.	ARY-220C	900
20	Al.Ch.	ARY-216D	1200
20	Westg.	CI	900
20	G.E.	IM-12	600
20	Westg.	CW-644C	600
20	G.E.	MT-322	900
20	G.E.	MT-503-4	1800
15	G.E.	MTC-9556	1200
15	G.E.	IM	1200
15	G.E.	IM	900
15	Westg.	CW	900
15	Al.Ch.	ARY216D	900
15	G.E.	ITC-5010	720
10	Al.Ch.	ANY	1200
10	Westg.	MW-306	1200
10	Al.Ch.	ARY-216C	900
7½	G.E.	MT	1200
6½	Reb.Mey.	425A	1200

2 COMPLETE VARI-VOLT D.C. DRIVES

M.G. Set, 290 K.W., D.C. gen., Elec type MPC, 250 volts, 800 amps, 1200 RM, dir conn. to 300 HP syn. motor, Gen. Elec. type TS. 3 ph. 60 cy. 440 volt, .8 PF, 1200 RPM

D.C. Motor, 250 H.P., Gen. Elec. type MPC, 245 volt, 730/975 RPM, with complete starting and control panels.

MOTOR GENERATOR SETS

K.W.	Make	A.C.	D.C.
1000	G.E.	4600	275
500	G.E.	2300	230
500	G.E.	440	250
500	G.E.	4000	1200
450	G.E.	2300	230
200	Cr.Wh.	2300	125
200	G.E.	440	250
150	Al.Ch.	220	125
100	G.E.	440	250
75	Star	440	230
75	G.E.	440	250
60	Al.Ch.	2300	110
60	Fr.Morse	220	125
50	Westg.	220	110
40	Cr. Wh.	220	125
25	G.E.	440	250
20	G.E.	440	250
20	G.E.	440	125
15	Ideal	220	125
10	Cr. Wh.	220	125
10	Ideal	220	125

LOW VOLTAGE—M.G. SETS

Amp.	Make	A.C.	D.C.
1500	Chandyn	440	60
1500	G.E.	2300	60
1000	Chandyn	440	40
333	Columbus	440	45

BALANCING SETS

4—34 K.W., 250 V., 270 A. neu. Beguc, type MCI, 125 V. gen. BB comp'd d/c on fab base

2—29 K.W., 250 V., 160 a. neu. Cr. Wh. type 151, 125 V gen 3 st. brg. Close coupled.

SYN. A.C. MOTORS

3 phase, 60 cycle—220 or 440 volt (*2300 volt or higher)

H.P.	Make	Type	P.F.	Speed
1000	*Westg.	SC-3D358	.8	900
700	*G.E.	ATI	.8	720
450	El.Mach.		1.0	240
320	*Al.Ch.	Dr. Prf	1.0	720
250	*Al.Ch.		1.0	720
200	*Al.Ch.		1.0	360
150	G.E.	ATI	.8	600
125	G.E.	TS-954S	1.0	1200
100	Cr.Wh.	103-S	.8	900
100	G.E.	ATB	.8	900

A.C. GENERATORS

3 phase, 60 cycle—220 or 440 volt (*2300 volt or higher)

H.P.	Make	Type	P.F.	Speed
1000	*Westg.	SO3D	.8	900
725	*G.E.	ATI	.8	720
250	*Al.Ch.		.8	720
156	G.E.	ATI	.8	600

First Source for 40 Years for Quality Electrical Equipment

CHICAGO Electric Co.

1320 W. CERMAK RD. • CHICAGO 8, ILL.

TRANSFORMERS

FOR SALE

2— 150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6— 100 KVA. 60 CY. 1 PH. 2400-240/120.
6 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.

5143 N. 2nd St. Philadelphia 20, Pa.

TRANSFORMERS — FOR SALE

1 Phase 60 Cycle
Rebuilt and Guaranteed

3—1250 KVA—G.E. 13800 2400
3—1000 KVA—G.E. 13800 480
3—1250 KVA—G.E. 6900 480
3—1000 KVA—G.E. 4800 480
6— 500 KVA—West. 2400 240/480
9— 333 KVA—West. 6900 480
9— 333 KVA—West. 4800 480
9— 333 KVA—West. 2400 480
3— 200 KVA—G.E. 2400 480/240
3— 150 KVA—G.E. 2400 480/240
3— 100 KVA—G.E. 2400 480/240
3— 100 KVA — G.E. 6900/11950Y 460/230
3— 75 KVA—West. 4800/2400 460/230
3— 50 KVA—G.E. 4800/2400 460/230/115
3— 37½ KVA — G.E. 4800/2400 460/230/115

We Also Solicit Your Inquiries for Special Transformers Including Furnace Transformers

BUFFALO TRANSFORMER CO.
1510 NIAGARA ST.
BUFFALO 13, N. Y.

BOILERS

10 to 1000 H P
NEW-USED
RECONDITIONED
Steam, Gas and Electric
Power Equipment
J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547-8-9

asme — BOILERS — Nat'l B'd.

2—400 H.P. Springfield sectional header
5—300 H.P. Combustion Engineering Co.
4—250 H.P. Stirling, Class-H.
2—600 H.P. Stirling type. Spreader stokers
3—72" } suspended H.R.T. single set
2—84" }

H. P. BREARLEY
34-23 31st STREET JACKSON HEIGHTS, N. Y.

ELECTRICAL CABLE

- for every industrial and power application
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
- Cut to length. Reasonably priced.

UNIVERSAL WIRE AND CABLE CO.
2668 N. Clybourn Ave., Chicago 14, Ill.

two 100 KW 250 Volt DC Generators. Steam driven by Ball Engines—140# pressure.

one 200 KW 250 Volt DC Generator. Steam driven by Ball Engine—140# pressure. Units complete with DC switchboard and two balancer sets.

one 20 ton York Vertical Ammonia Compressor. Steam driven by Corliss Engine—140# pressure.

one 15 ton York Vertical Ammonia Compressor. V belt drive. 33 H.P.— DC motor. Complete with condenser, receiver, valves, gauges, etc.

PURITY BAKERIES
97 E. 12th Street St. Paul 1, Minn.

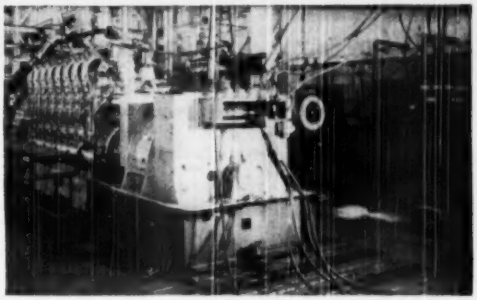
DIESEL POWER

AT 40% TO 60% SAVINGS

EACH ENGINE "REMANUFACTURED"
AND "FULL-LOAD TESTED"
PRIOR TO SHIPMENT

INSPECTION INVITED

ALL EQUIPMENT OFFERED WITH ONE YEAR GUARANTEE



VIEW OF ENGINE TEST STAND FACILITIES AT OUR PLANT IN SAUSALITO (S.F.) CALIF. ALL ENGINE TESTING CONFORMS TO DIESEL MANUFACTURERS' STANDARD METHODS.

A PARTIAL LIST OF OUR INVENTORY

KVA	MAKE	MODEL	HP	RPM	KVA	MAKE	MODEL	HP	RPM
1875	Fairbanks Morse	33E16	2000	300	312.5	Clark	MD-4	375	327
1420	Fairbanks Morse	38D	1600	720	300	Fairbanks Morse	YVA	360	257
1250	General Motors	16-278A	1600	720	250	General Motors	8-268A	350	1200
1000	General Motors	12-278A	1200	720	237	Ingersoll-Rand	S	255	600
937.5	General Motors	12-567	1080	720	200	Buckeye	80	240	600
625	Alco	6-12½x13T	750	600	156	Buckeye	E	190	400
425	Baldwin	VO	510	450	125	General Motors	3-268A	150	1200
400	Buckeye	80	480	600	121	Fairbanks Morse	32E14	140	300
375	Enterprise	DSG-6	450	450	75	General Motors	6-71	90	1200
330	Superior	KNA	396	514	62.5	Int'l Harvester	UD-18	76	1200
312.5	General Motors	8-268A	450	1200	50	General Motors	4-71	60	1200

A. G. SCHOONMAKER COMPANY, INC.

52 CHURCH STREET, NEW YORK 7, N. Y.

SHOPS AND WAREHOUSE: JERSEY CITY, N. J. AND SAUSALITO (S.F.) CALIFORNIA

COMPRESSORS
VACUUM PUMPS
"AMERICAN" Rebuilts
Since 1902
DISCRIMINATELY DIFFERENT
SAVE 40%-60%
— SALE OR RENT —
STATIONARY — PORTABLE

PORTABLE
60 CFM Chicago, Gas, Starter, Hose Reel, 2 Pneumatics. Rental or Rental Purchase.

American Air Compressor Corp.
47th & Dell Ave., North Bergen, N. J.

NEW and REBUILT
MOTORS
GENERATORS
TRANSFORMERS
1 to 1800 H. P.
ELECTRIC EQUIPMENT CO.
ROCHESTER 1, NEW YORK
Write For Free 1950 Catalog

NORTHERN METAL CO. — *MACHINERY* at REDUCED PRICES

DIESEL GENERATORS

100 K.W. Allis Chalmers. 1944. 3/60/120/450.
Exciter: 3 K.W. 120 V. D.C.
Diesel Engine: Lorimer. Model F5SS. 150 H.P. 7½"x9½".
5 cylinder, with electric starting motor.

MOTORS

Westinghouse. 1944. Synchronous—Induction.
60 Pole. 3300 S.H.P. 3 Phase. 82.5 Cycles. 2200 Volts.
165 R.P.M. Power Factor 100%.
Exciter: 125 Volts D.C. Load Factor 100%. 1944.

BOILERS

WATER TUBE. Babcock & Wilcox. 1945. 2 Drum. Bent Tube. Economisers. Internal Desuperheater. Superheaters. W.P. 400 P.S.I. Hydrostatic Press. 718 P.S.I. Heating Surfaces: 2441 sq. ft. Superheater 350 sq. ft. Economiser 1620 sq. ft. 3 Todd "Hex Press" Fuel Oil Burners. Diamond Soot Blowers. Auxiliaries available.

NUMEROUS OTHER ITEMS ARE AVAILABLE

MILNOR & BLEIGH STS. • PHILA. 35, PA.
Phone MAyfair 4-1400

Reliably Rebuilt Electrical Equipment

Rebuilt — 1 YEAR GUARANTEE

PARTIAL LISTINGS ONLY

MOTORS
Squirrel Cage 3 Phase

HP	Make	Type	Speed
450	GE(vert)	KF-6338	1180
200	Wagner	RP2	1750
200	GE	KF-6335	880
150	West(2)	CS	1750
150	West	CS	580
125	AlCh(2)	AR	435
100	Wagner New	XP	1150
100	GE	K-544	1175
100	West	CS	870
100	GE	IK	720
75	West	CS	1750
75	GE(3)	K-505	1175
75	GE	IK	900
75	GE(3)	KT-352	865
75	West	CS	720
75	GE	K-356	690
75	GE	KT-558	580
60	F-M	Tot.Enc.	1800
60	West(2)	CS-607	880
60	Rel(2)	AA	875
60	GE	KT-346	865
50	GE	FTR-523	3600
50	Elliott	198	3450
50	West	CS	1740
50	LA(3)	XP	1150
50	West	XP	1150
50	GE	KF-445	1170
50	West	CS-642C	1160
50	West(3)	CS	870
50	GE(2)	IK	870
50	GE	FTR-542	870
50	West	CS	690

MOTORS
Slip Ring 3 Phase

HP	Make	Type	Speed
600	CrWh	121AQ	507
500	GE	IM	1200
500	GE(2)	IM	450
400	West	CW	514
225	Wagner	25cy	710
200	GE	MTP-557	1800
200	GE(2)	IM	1170
150	Wagner	31VRN	900
150	GE	MT-564Y	580
100	GE	MT-553	1165
100	AlCh		690
75	West.	CW	1150
75	GE		690
50	West.	HF	850
50	AlCh		690
50	GE	MT-536	1150
50	West	CW	1150
50	GE	MT-336	1150
50	LA	OGH	870
50	F-M	BV	600
50	AlCh	ARY	575
50	GE	IM	490

MOTORS
Synchronous

HP	Make	Type	Speed
600	AlCh(2)		120
475	West		720
400	GE(2)	TS-928S	600
300	GE	ATI	900
260	GE	TS	900
250	Ideal		360
200	GE(2)	25cy	500
200	Ideal	SMW	257
180	GE	ATI	900
160	GE	TS	1200
145	GE	ATI	720
135	West	G	1200
135	Ideal		1200
100	GE	TS	1200
100	ElMach		200
55	ElMach	BRKT	1200

MOTORS — 230V. D.C.

HP	Make	Speed
400	AC	415
135	CW	233/900
125	GE	1750
100	GE	1750
100	AlCh	1150
90/45	GE	950/475
75	Sprague	1000/1500
75	West(2)	475
75	CrWh	480/670
75	CrWh	375/950
75	West(3)	250/1000
60	West(3)	680
50	GE	1750
50	Diehl	850/1050
45/90	GE	475/1950
50	West(3)	565
50	GE	250/1000
50	West	250/1000
40	West	1750
40	Century	1740
40	GE	1700
40	GE	1100
40	GE	750
40	GE(2)	400/1500
40	CrWh	700
40	Rel	400/1200
35	West	1150
35	GE	440/800
30	GE(8)	2200
30	West	975
30	Cont	850
30	GE	775
30	West	500/1500
30	West(2)	575
25	GE	1750
25	West	1750
25	GE	1750
25	ED	1500
25	Rel	1150
25	West	500/1500
25	West(2)	600
25	GE	300/1200

MOTORS—550V. D.C.

HP	Make	Speed
765	GE(6)	1045/1350

GENERATORS
250V. D.C. M.D.

KW	Make	Speed
1000	GE	900
500	West	1100
300	Elliott	1200
300	GE	1200
300	AlCh	1200
200	GE	1200
150	West	900
100	Deleo	1200
75	GE	1200
50	GE	1200
40	Rel(4)	1750
42	ABC(2)	1200
30	GE	1200
25	GE	1200

GENERATORS
125V. D.C. M.D.

KW	Make	Speed
250	GE	720
150	CrWh	1200
150	West	1150
100	West(2)	900
100	GE	1200
100	ElMach	1200
75	CrWh	1200
75	Hertner	1150
50	West	1150
50	CrWh	1150
50	Sturt	2800
35	Ideal	1200
30	GE	1150
30	LA	1450
25	ElMach(2)	1150

A.C. GENERATORS
Driven by D.C. Motors

KVA	Make	DC Input	AC Output
288	West	115	450
75	GE	230	240
50	Star	115	120
35	GE	230	220
31	Ideal	115	440
31	ElMach	230	440
18	GE	230	120/240
10	Burke	115	120
7½	Hertner	115	440
5	ElSpec	115	110
1¼	AlCh	230	110

GENERATORS—A.C.

KW	Make	Type	Speed
216	West	G	900
180	GE	ATB	900
100	GE	ATB	360
75	GE(2)	ATB	1200
50	F-M	GG	1200
15	GE	ASI	1200

TRANSFORMERS

4—333 KVA Moloney, 2300/4600 V. primary, 230/460V. secondary.
1—300 KVA, Al. Ch. 3 ph. 4160 V. primary, 230V. secondary.
1—300 KVA, Pittsburgh, 3 ph, 41600 V. primary, 230V. second.
8—100 KVA West. 3 ph. 440-220 Dry.
2—50 KVA GE—H—KF, 2400/4160Y—120/240V. secondary.
4—25 KVA West 440V. primary, 110/220V. secondary.
3—15 KVA West 440V. primary, 110/220V. secondary.
60—Additional Oil and Insulated Dry-type Transformers in stock not listed, down to 1 KVA.

L. J. LAND, INC.

EST. 1910 — 41st YEAR

156 GRAND ST. CAnal 6-6976 NEW YORK 13, N. Y.

UNIT SUBSTATIONS
FOR SALE

2—New 500/1000 K.V.A. General Electric Type HUT, Oil Immersed, Self-Cooled, 55° C. Rise 12,000-2400/4160Y Volts, 3-Phase, 25/60 Cycle, Master, Outdoor, Unit Sub-stations, for One Incoming 12,000 Volt, 3-Phase, 3-Wire Circuit and Two Outgoing 4160 Volt, 3-Phase, 4-Wire Circuits, Connected and Assembled for Operation at 60 Cycles, 1000 K.V.A. Rating.

Price and Detailed Specifications will be furnished upon request.

SALT RIVER POWER DISTRICT
P.O. BOX 1980
PHOENIX, ARIZONA

1—72x18 Code 150# HRT Boiler—excellent
1—150 HP BRAND NEW Slip Ring Motor
1—35 HP Dutton Code Model 864 Boiler
1—10' 10 ga. capacity Power Press Brake
2—150 KVA F-M Diesel Eng.—Gen. Sets
2—100 KW Steam Engine—Generator Sets
2—500 HP 450# B&W Water Tube Boilers

H. & P., 6719 ETZEL, St. Louis 14, Mo.

ALLIS CHALMERS M-G SET

Syn. Motor 1085 KVA/3/60/208-220V/720 RPM/-2840 Amps. Ser. #111500.
Generator:—750 KW DC 250 Volt 3000 Amps. 720 RPM Ser. #111501. The above is a 3 bearing Factory Built Unit, with AC starting equipment and DC panel.

ALBERT HELLER CO.
210 Snediker Ave. Brooklyn 7, N. Y.

TWO STOKERS, COMPLETE

Detroit Overfeed Rotostoker—double feed. Capacity: 500 boiler H.P. Grate area: 45 sq. ft. Grate dimensions: 6 ft. x 7 ft. 6 in. Stokers complete with forced draft fans. Stoker parts: 4 feed units, 2 drive units, 2 blower fans, 2 wind tunnels, 2 set grates, 2 boiler fronts for mounting feed units.

PURITY BAKERIES
97 E. 12th St. St. Paul 1, Minn.

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

BOILER UNITS

1—140,000# New Steam Generator 600#, also Super
2—90,000# Boilers, 625#, 825° F.tt., Economizer and Air-heater
2—60,000# B&W 450# superheat
3—30,000# B&W 450# superheat
1—1000 HP Erie City Boiler, 200#
3—600 HP Box Header Straight Tube 200#
6—600 HP Each Bent tube type 200#, superheat
2—750 HP B&W Sectional Header, Super., 200#
1—45,000# F-W 450# 3 drum, water walled & economizer
2—500 HP B&W Sectional Header 200# Boilers
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS

1—10,000 KW Turbo-Generator—Cond.
1— 7,500 KW Turbo-Generator—Cond. 600#
1— 7,500 KW Turbo-Generator, Cond.
1— 5,000 KW NEW 400# Cond. Unit complete
1— 3,000 KW Turbo-Generator—Cond.
2— 3,000 KW & 2—2500 KW Cond.
3— 2,000 KW same as above
2— 1,500 KW same as above
2— 1,250 KW same as above
2— 1,000 KW same as above
1— 500 KW same—Also 750 KW & 300 KW Units
Non-Cond.:—300—500—750—1000—1500—2000

Also 400# & 600# Turbos

Complete Steam Plants with 2—1250 KW; 2—2500 KW; 2—3000 KW & 7500 KW
Frequency Changers—Transformers! Send us your requirements—We may have it.
Send us your INQUIRIES for ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. NEW YORK 7, N. Y.

STEAM GENERATOR

One (1) Erie City Iron Works Steam Generator, Cross Drum (54" dia.) straight tube (3¼" dia. x 18'-0" long) box header design, vertical baffles, 6510 sq. ft. heating surface, refractory setting, furnace width 10'-9¼", designed for 250 lb. operation (520° FTT) Foster economizer and superheater, and fired by Westinghouse multiple retort underfeed stoker. Built in 1929.

FS-7122, POWER
330 W. 42 St., New York 18, N. Y.

MOTORS • GENERATORS • TRANSFORMERS

200 KW M.G. SET

200 KW Westinghouse NEMA Frame Generator 250 V. DC 1200 RPM direct Connected to
300 HP. Westinghouse Synchronous Motor 3/60 220/440 Volts 1200 RPM.
AC & DC Panels—Like new. Ship now.

MOTORS

60—50—25 CYCLE
In stock—all sizes
Slipring — Squirrel Cage — Synchronous
All types of control equipment.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

DIRECT CURRENT EQUIPMENT

125-250 Volt Motors, Generators and M-G Sets with controls.

SLIPRING MOTORS

500 HP Allis Chalmers type ANY-WR 3 phase, 60 cycle, 2300 volt 514 RPM.
100 HP Westinghouse type CW 3 phase, 60 cycle, 220/440 volt 450 RPM.

FREQUENCY CHANGERS

All Sizes in Stock. 60 cycle to 90 cycle, 100 cycle, 120 cycle, 180 cycle and any other high cycle.

ALL ITEMS IN STOCK FOR IMMEDIATE SHIPMENT

NIAGARA TRANSFORMERS

1 Phase — 60 Cycle — New

Stock Shipment on sizes listed. Short delivery on sizes up to 5000 KVA—1 or 3 phase, in voltage ratings to 69 KV. Standard taps. Built to A.I.E.E. —N.E.M.A.—A.S.A. Standards.

LISTING OF TRANSFORMERS

Quantity	KVA	Primary	Secondary
3	15	7200/12470Y	240/480
3	15	2400/4160Y	240/480
3	25	2400/4160Y	120/240
6	25	2400/4160Y	240/480
3	25	7200/12470Y	240/480
3	37½	2400/4160Y	120/240
6	37½	2400/4160Y	240/480
9	50	2400/4160Y	240/480
5	50	2400/4160Y	120/240
4	75	2400/4160Y	120/240
6	75	2400/4160Y	240/480
3	100	2400/4160Y	120/240
12	100	2400/4160Y	240/480
3	167	2400/4160Y	240/480
3	167	2400/4160Y	120/240
6	250	2400/4160Y	240/480
3	333	2400 x 4800	240 x 480
3	500	7200/12470Y	240 x 480

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

BREW-WOLTMAN OFFERS

TURBINE UNITS

1—3000 KVA G. E. Non-C. 60 cy. 13200 V. 600-lb.
1—3125 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lbs., 40 lbs. BP.
1—2500 KVA G. E. Extraction Cond. 60 cy. 480 V. 185-200 lbs. steel valve sheet.
1—1563 KVA G. E. Extraction Cond. 60 cy. 480 V. 200-lbs.
1—1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lbs.
2—1250 KVA Elliott Cond. 60 cy. 480 V. 150-200 lbs. 600° Surface Condenser.
1—1250 KVA DeLaval Non-C. 60 cy. 2300 V. 250-lb.
1— 25 KW Allis Non-C. DC 125 V. Exciter. Dual drive turbine & motor.

DIESEL ENGINE UNITS

2—1400 HP Fair. Morse 2400 V. 60 cy.
3—700 HP Gen. Motors 2300 V. 60 cy.
3—650 HP Amer. Loco. 440 V. 60 cy.
1—600 HP Fair. Morse 2400 V. 60 cy.
1—400 HP DeLaVergne 2400 V. 60 cy.

STEAM ENGINE UNITS

1—312 KVA Skinner Uniflow, 480 V.
1—312 KVA Ames Uniflow, 240 V.
1—250 KVA Ames Vertical Uniflow, 480 V.
2—187 KVA Ames Vertical Uniflow, 240/480 V.

ROTARIES—60 Cy.

1—3700 KW G.E. 225/285 V DC 13800 V AC 300 RPM
1—2000 KW A.C. 600 V DC 4150 V AC 514 RPM
2—1000 KW Wmt. 600 V DC 4150 V AC 720 RPM
1—1000 KW G.E. 600 V DC 13200 V AC 900 RPM Auto.
3— 750 KW Wmt. 600 V DC 11000 V AC 1200 RPM Auto.
2— 500 KW Wmt. 250 V DC 13200 V AC 1200 RPM

SPECIALS

3—700 HP General Motors Diesel 8 cyl. 4 cy. 360 RPM dir. con. to 485 KW .8 PF 3/60/2300 V. generators.
2—1250 KVA Elliott 3/60/480 V. 3600 RPM generators dir. con. to 150-200 lbs. IP 600° TT turbines with dir. con. exciters surface condensers & pumps.

MOTOR GENERATOR SETS

2—1500 KW G. E. 600 V. DC 4150 V AC 600 RPM
2— 500 KW Wmt. 250 V. DC 2200 V. AC 1200 RPM
1— 500 KW Wmt. 125 V. DC 2300 V. AC 720 RPM
1— 300 KW Wmt. 250 V. DC 440 V. AC 1200 RPM
1—200 KW G. E. 250/275 V. DC 2300 V. AC 1200 RPM
1— 75 KW Star 240 V. DC 440 V. AC 1200 RPM
1— 75 KW Wmt. 125 V. DC 440 V. AC 1200 RPM

SYNCHRONOUS CONDENSERS

1—2500 KVA G. E. 2400/4160 V. 720 RPM
1—2000 KVA Wmt. 2300 V. 720 RPM
2—1500 KVA G. E. 2400/4160 V. 900 RPM
1—1500 KVA G.E. 4600 V. 1000 RPM
1—1000 KVA Wmt. 2300 V. 900 RPM

SYNCHRONOUS MOTORS—60 Cy.

1—4350 HP Cr. Wh. 13800 V. 514 RPM
1— 800 HP Ideal 4150/2400 V. 1200 RPM
1— 600 HP G. E. 440 V. 600 RPM
2— 350 HP G. E. 2300 V. 257 RPM
1— 300 HP G. E. 2300 V. 600 RPM
1— 300 HP Wmt. 2300 V. 900 RPM

MERCURY ARC RECTIFIERS

2—4500 KW Multi. Anode 600 V. DC
2—3250 KW Ignitron 600 V. DC
1—1000 KW Ignitron 600 V. DC

FREQUENCY CHANGERS

1—2500 KVA G. E. 25/60 cy. 300 RPM
1—1250 KVA Wmt. 25/60 cy. 360 RPM
2—1000 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA Al. Ch. 25/60 cy. 300 RPM

TRANSFORMERS—60 Cy.

1—7500 KVA G. E. 138000—41000, 3 ph.
2—3333 KVA G. E. 69000—6900
1—7000 KVA Al. Ch. 66000—2400, 3 ph.
1—4500 KVA G. E. 00000—33000, 3 ph.
3—1000 KVA Wmt. 66000—2700
3— 75 KVA G. E. 44000—2300 4600
1—3500 KVA Wmt. 34500—13750, 3 ph.
1—5000 KVA G. E. 33000—2300/4600, 3 ph.
3— 667 KVA G. E. 33000—2300/4600
6— 75 KVA Moloney 33000—2300/b400
3—3750 KVA Wmt. 26400/13200—2400
4— 450 KVA Al. Ch. 25410/44000—13200/23000
1—7500 KVA G. E. 13800 Rectifier type
3— 333 KVA G. E. 13200—2400/4160 Y
3— 750 KVA Wmt. 13200—440
3— 167 KVA G. E. 7200/12400—240/480
1—1500 KVA Wmt. 4000—2300, 3 ph. Auto
3— 250 KVA Al. Ch. 2300—460

OIL CIRCUIT BREAKERS

1— 800 A. 73 KV G. E. FHKO-139 Outdoor
1— 400 A. 37 KV G. E. FHKO-136-CS Outdoor
1—1200 A. 34.5 KV G. E. FKO-330-1000 Outdoor
4—2000 A. 15 KV G.E. FKO-339-1000 Outdoor
4— 600 A. 15 KV G. E. FHKO-138BS Outdoor
2— 600 A. 15 KV Wmt. B-28-B Indoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW-WOLTMAN & CO., INC.

50 Church Street New York City 7 WOrth 4-1470

NO YOU CAN'T BEAT GLOW FOR RELIABLE ELECTRICAL EQUIPMENT

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Westgh
350	3550	2200	Westgh-CS
300	900	440	GE-I-17
250	1200	440	GE-KT8
250	600	2300	Triumph
225	514	440	GE-I-14
200	600	440	Westgh-CS
150	1800	440	Howell-SC
150	600	2200	GE
125	3600	220/440	AlCh.AN
125	1800	220/440	AlCh.AB
125	540	220	AlCh.

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg
400	1200	2300	AlCh.
375	1800	2300	AlCh.
350	900	2300	Westgh
300	720	2300	AlCh.
250	720	440	GE-MT
250	300	2300	AlCh.
200	1800	440	AlCh.
150	1750	440	GE-MT
150	900	2200	AlCh.
100	1200	550	Westgh-CW
100	400	440	W-E-118

MOTOR GENERATOR SETS

KW	DC Volts	HP	AC Volts	Make
1800	250	2500	4000	GE
750	240	1100	2300	GE
400	250	600	220/440	GE
300	250	442	440	GE-EM
200	250	300	440	GE
150	250	225	440	C-W-EM
100	275	150	440	Wtg.
75	125	115	440	GE
50	125	100	2300	AlCh.
33	125	50	440	GE
25	230	40	220	Reliance-GE
20	250	30	220	GE

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
3000	720	4800	Wtg.
1015	500	2200	Wtg-25 cycle
500	514	440	GE
435	720	2300	GE type ATI
320	900	2300	GE-ATI
250	1800	2200/4160	GE-ATI
250	225	2200	GE-TS
225	900	4100	GE-ATI
220	600	2300	GE-ATI
175	225	220	GE-TS (rotor & stator only
160	600	440	GE-ATI
160	164	480	GE-TSLF (rotor & stator only
150	1800	2200	GE
150	1800	220	GE-ATI, single bearing
150	900	440	Star
150	720	440	Westgh

FREQUENCY CHANGERS

KW	Output Volts	Input Volts	Make
2000	2300	2300	GE
1700	250	Any	GE-HCC
1100	250	Any	GE-HCC
100	2300	275	Wtg.
25	220	115	GE
20*	220	220	Delco
15*	220	220	GE
10**	220	550/220	GE

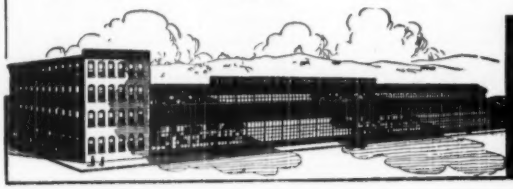
*60/180 cycles—**60/240 cycles

CAPACITORS

KVA	Volts	Phase	Make
75	440	1	Cornell-Dubilier
60	460	3	Westinghouse
15	460	3	General Electric
15	2400	1	General Electric

GLOW ELECTRIC CO., for over 44 years, has done engineered rebuilding of electrical equipment to assure you of quality and dependability.

We invite your inquiries.



GLOW ELECTRIC CO.
927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

Quality SINCE 1906

Wente Motors

WIDE SELECTION UNUSUAL VALUES

THEIR ELECTRICAL CONSTRUCTION HAS BEEN REBUILT... BY EXPERTS

SQUIRREL CAGE
3 ph.—60 cy.—220 or 440 V. (Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	G.E.	I (2200 V.)	900
3	50	Al. Ch.		900
1	60	G.E.	KT	1800
4	60	G.E.	KT (2200 V.)	1200
1	60	Reliance	AA	900
1	60	West.	CS (TEFCBB)	1200
1	75	West.	CS (TEFCBB)	1200
1	60	West.	CS Gearhead	232
1	100	G.E.	KT (2200 V.)	900
4	100	G.E.	K (TEFCBB)	1200
1	110	G.E.	KTP	1800
1	120	G.E.	PT	3480
8	125	Al. Wh.	AR	450
2	150	Al. Ch.		1750
1	350	G.E.	KF (Vert.)	3600

SLIP RING—SYNCHRONOUS
3 ph.—60 cy.—220 or 440 V. (Other voltage as noted)

1	50	Al. Ch.		720
1	50	Ideal	AV	600
1	50	G.E.	I	700
1	60	Ideal	AVX	1200
1	70 KW	G.E.	TS (.7PF)	1200
1	75	West.	CW	600
1	75	G.E.	I	520
1	75	Ft. Morse	BY (2200 V.)	1800
1	100	G.E.	TRB (1.0 PF)	600
1	100	G.E.	I-16 (2200 V.)	450
1	100	KW G.E.	ATB (.8 PF)	900

Qu.	HP	Make	Type	Speed
1	125	KW G.E.	TS (.7PF)	1200
1	135	Ft. Morse	T (2400 V) (PF1.0)	900
1	150	West.	CW	450
1	200	West.	CW (S Bear.)	600

D.C.—230 VOLT (Other voltage as noted)

1	50	West.	SK	850
1	50	G.E.	CD 1341	500/2000
3	50	Reliance	T	2700
1	50	West.	SK (115 V.)	500
1	60	West.	SK (115 V.)	500/1500
1	75	Diehl	K11	700
2	75/100	Reliance	T1050	300/900
1	100	West.	SK	850
1	100	Cr. Wh.	CM	600
1	130	Cr. Wh.	CMC (550 V.)	1300
1	150	West.	SK	400/1300
1	150	West.	SK	850
1	180	Cr. Wh.	CMC	450
3	200	Reliance	T2550	300/900
2	200	G.E.	TLC-74	1350/4000
1	225	West.	SK	1050

M-G SETS

1— 45 KW West. 60 V DC—440 V AC 1200 RPM
4— 60 KW G.E. 60 V DC—440 V AC 1200 RPM
5— 75 KW Ft. Prod. 220 V DC—440 V AC 1200
1—100 KW West. 250 V DC—440 V AC 1200
1—100 KW West. 250 V DC—440 V AC 900
1—100 KW Reliance 250 V DC—220 V AC 1200
1—100 KW Ridge 275 V DC—440 V AC 1200
1—150 KW G.E. 275 V DC—440 V AC 900
ALSO—4000 meters other than listed from 1 HP to 200 HP

Wente SINCE 1906 — The Wente Electric Co., Hamilton — 203 NO. FOURTH ST. Phone 4-8128 — Ohio

TRANSFORMERS FOR SALE

Single Phase, 60 Cycle

3—200KVA Maloney 44000/22000-440/220

15—40KVA 2200-275/240

3—30KVA Western Electric 1100/2200-110/220

4—25KVA GE 2400/4160Y-120/240, 2500/4330Y-125/250

1—25KVA Allis Chalmers 2400/2150-120/240 2500/2250—125/250

8—25KVA GE 2200/3810Y—122/244

2—25KVA GE 2200-244/488

1—25KVA Westinghouse 480/240—240/120

3—15KVA GE 2200/3810Y—244/488

5—15KVA GE 2400/4160Y—120/240, 2500/4330Y—125/250

3—15KVA GE 1980/2200/3801Y—244/488

6—15KVA GE 2200/2090/1980—244/488

3—15KVA Maloney 1100/2200—240/480

3—10KVA GE 2200—110/220

GAVENDA BROS., INC.
CANTON, ILLINOIS PHONE 739

GENERATE YOUR OWN POWER WITH "UTILITIES APPROVED" EQUIPMENT

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

6250 KVA G.E. condens., 5 stage, 2300/4000 volts, 200# pressure, 600° TT, 3600 RPM.

3125 KVA G.E. condens. 130 P.S.I. 550 volts.

3125 KVA G.E. condensing 175/200 P.S.I., 2300 volt, 500° TT, 3600 RPM complete.

2500 KVA G.E. Type ATB Form HT, 2300/480 volts, 3600 RPM alternating current generator LESS TURBINE.

1563 KVA G.E. non-condensing 250 P.S.I. 25# gauge back, 2400 volts, 3600 RPM.

1563 KVA G.E. condensing 250 P.S.I. 2300 volts, 3600 RPM complete.

625 KVA Allis-DeLaval non-cond. 80 to 125 P.S.I. 10 to 15# gauge 2300/480 volts.

625 KVA Westinghouse condensing 150/200# pressure, 2300 volt, 3600 RPM complete.

625 KVA G.E. non-condensing 150# P.S.I. 20# back, 480 volt, 3600 RPM complete.

375 KVA (4) G.E. condensing 400# pressure, 480/600/2300/4150 volts complete.

112 KVA G.E. non-condensing 125# pressure 10# gauge back 480 volts.

100 KVA Westg. non-condensing 125 to 150# pressure, 10# gauge back, 2400 volts.

Direct Current

400 KW (2) 240 volts direct current Crocker-Wheeler Worthington 440 lbs. condens.

150 KW (2) 3 wire, 250 volts, 225/250 P.S.I. Westinghouse-Worthington condensing.

100 KW G.E. 125 volt 200-275 P.S.I.

75 KW Allis-Chalmers-Terry, 125 volts, 2400 RPM, 150# pressure non-condensing.

75 KW (2) Westinghouse - Moore 120 volt, 200# pressure, condensing.

60 KW (3) new Westinghouse 120 volt, 200# pressure, condensing.

SYNCHRONOUS MOTORS

3 Phase, 60 cycle

5000 KVA Westghs. 4000 volt. 720 RPM Electrical Synchronous (condenser)

900 HP Allis, 2200 volts, 150 RPM

750 HP G.E. 2300 volts, 720 RPM.

300 HP 80% P.F. G.E. 2300 volts, 720 RPM

MOTOR GENERATOR SETS

500 KW General Electric 600 volt DC, direct connected to 710 HP, 3 phase 60 cycle, 2300 volt, 720 RPM synchronous motor.

400 KW General Electric 275 volt DC, direct connected to 710 HP, 3 phase 60 cycle 2300 volts, 720 RPM synchronous motor.

300 KW Allis, 250 volts DC generator direct connected 430 HP Allis 3 phase 60 cycle, 440 volt, 1200 RPM synchronous motor.

150 KW G.E. 125 volt direct current generator direct connected 225 HP, 3 phase 60 cycle 220 volt, 1200 RPM synchronous motor.

62½ KVA G.E., 60 cycle, 2300 volt, alternator to 75 HP, 125 volt DC motor.

ENGINE-GENERATOR UNITS

Direct Current

400 KW G.E. 240 volts, 360 RPM generator connected Skinner Unaflow vertical engine 150#, 10# gauge back.

275 KW Westinghouse 250 volt, generator connected Ames vertical Unaflow engine.

250 KW (2) G.E. 3 wire 250 volts generators connected Skinner Unaflow Engines.

100 KW Burke 3-wire, 250 volt generator connected Skinner Unaflow engine.

Alternating Current—3 phase, 60 cycle

750 KVA G.E. 2300 volts generator connected Skinner Vertical Unaflow non-condensing engine 150# P.S.I.

625 KVA Westinghouse 240 volts, generator connected Skinner Unaflow Engine.

500 KVA G.E. 2400/480/240/volts generator connected Ames Vertical Unaflow Engine.

375 KVA G.E. 2300/440 volts, generator connected 23"x24" Skinner Horizontal Unaflow Engine 120—150 P.S.I.

175 KVA Westg. 240 volt generator connected Skinner Horizontal Unaflow Engine.

AUGUST BARGAINS

1—13,600, 1—8500, 1—8400, 1—4400 sq. ft. surface condensers.

4—900 KW, 250/375 volt, direct current generators connected 1200 HP, 8 cylinders 720 RPM Fairbanks Diesel Engines.

1—5425 GPM, 70 foot head Centrifugal pump connected 125 HP 60 cycle, 2200 volt, 1750 RPM G.E. motor.

2—1000 GPM, 1270 foot head, 4-stage, Morris pumps each direct connected to a 417 HP, 390# P.S.I. non-condensing G.E. turbine.

UMC UTILITIES MACHINERY CORP.

1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422

MOTORS—M.G. SETS—TRANSFORMERS

SQUIRREL CAGE MOTORS
3-Phase 60-Cycle

Qu.	H.P.	Make	Type	Volts	RPM
1	400	G.E.	I-K	2300	514
1	400	G.E.	KT-412	2200	435
1	250	Whse.	CS	2200	1160
1	200	Al. Ch.	AK	220/440	580
1	150	C.W.	126Q	220/440	570
1	125	White.	CS-761C	220/440	1750
1	125	Whse	CS-7728	2200	1170
2	125	C.W.		220/440	430
1	125	Al. Ch.	AR	220/440	435
1	100	G.E.	IK	220/440	1750
2	100	White.	CS-605C	220/440	1750
1	100	Al. Ch.	AR-226	2200	1160
1	100	G.E.	KT-556	2200	865
5	100	P.M.	HS	220/440	880
1	100	Al. Ch.		550	720
1	100	F.M.	H-241B	220/440	450
1	75	Whse.	CS	440	1750
1	75	Al. Ch.	AR	2200	1765
1	75	Burke	EM-10	550	720
3	50	Whse.	CS	220/440	600

SYNCHRONOUS MOTORS
3-Phase 60-Cycle

Qu.	H.P.	Make	P.F.	Volts	R.P.M
1	700	G.E.	80	2300	720
1	450	G.E.	80	440	360
1	400	Whse.	80	440	600
1	300	Whse.	100	440	450
1	208	Al. Ch.	100	2200	900
1	250	G.E.	80	2300	600
1	200	Whse.	80	440	300
1	150	G.E.	100	2300	100
1	150	G.E.	80	550	450
1	150	Whse.	100	2200	400
1	125	G.E.	80	2300	900
2	100	Whse.	90	440	1800
1	100	Whse	100	2200	1200
1	100	Ideal	80	440	900
2	100	G.E.	80	440	600
1	60	G.E.	80	440	1200
2	50	G.E.	80	2200	600

SLIP RING MOTORS—CONSTANT DUTY
3-Phase 60-Cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1**	3000	G. E.	MT	2200	356
1**	2000	G.E.	MT-30	2300	210
1**	1500	Al. Ch.	ANY	2200	270
1**	1200	Cr. Wh.		2200	257
2**	1000	Al. Ch.	ANY	2200	235
1**	800	G. E.	MT-12	6600/2200	300
1**	700	G.E.	MT-432	2200	400
1**	600	G.E.	MT-412	2200	710
1*	500	Whse.	C.W.	2300	515
1	500	G.E.	MT-412	2200	450
1	400	G.E.	I-E17-M	2300	870
1**	400	G.E.	I-M	2300	590
1**	400	Al. Ch.	ANY	2200	565
1	400	G.E.	MT-412	2200	410
1	300	G.E.	I-E15-M	2200	1200
1	300	Al. Ch.	ANY	2200	705
1	250	Whse.	CW-1106	2200	580
1	250	Whse.	C.W.	550	514
1	200	Al. Ch.	ANY	2200	585
1	200	Whse.	C.W.	440	600
1	150	G.E.	I-E13-M	2200	1750
1	150	G.E.	I-16-M	440	495
1	125	Whse.	C.W.-870	2200	900
1	100	F.M.	H20-C	440	900
1	75	G.E.	I.M.	440	695
1	50	G.E.	MT-536	2200	1150
1	50	Al. Ch.		2230/440	514
1	40	Al. Ch.		2240/440	435

**Mill Type Pedestal Bearing.
NOTE: Some of these motors can be furnished as S Bearing.

TRANSFORMERS—(OIL COOLED)

Qu.	K.V.A.	Make	Type	Ph.	Volt.
2	4500	G.E.	HT	3	27000/13500/2300
3	500	G.E.	H	1	13200/11850/220/440
3	200	Pitts.	OISC	1	14400/12600/220/440
3	150	Pitts.	OISC	1	23000/22000/2300/4600
3	150	G.E.	B	1	19000/9500/550/2300
3	100	Whse.	SS	1	12075/10915/230/460
3	100	G.E.	B-KF	1	4160/120/240
3	75	G.E.	B-KF	1	2400/4160Y/120/240
2	50	Al. Ch.	OISC	1	22000/220
2	50	Wagner	HE	1	13200/11850/575/287

MOTOR GENERATOR SETS

Qu.	K.W.	Make	R.P.M.	D.C. Volts	A.C. Volts
2	1500	G.E.	600	600	4160/2400
1	1250	Al. Ch.	720	525	4800/2400
1	1000	Whse.	514	550	4160/2300
1	1000	Whse.	514	275	4160/2300
1	600	Al. Ch.	900	250	2200
1	400	Whse.	900	250	4600/2300
1	300	G.E.	720	250/125	2200/440
2	150	C.W.	900	250	2300/440
1	100	Ridgway	1200	275	4000/2300
1	75	Al. Ch.	900	250	2300
1	75	Whse.	1200	125	440
1	75	Whse.	1200	250	2300/440
5	75	Star	1200	250	440/224
1	50	Reliance	1750	250	440/224
1	50	Reliance	1750	250	440/224
(4 units variable voltage set with 5 K.W. exciter-					
1	50	Reliance	1750	250	440/224
1	35	G.E.	1750	125	440/224
2	25	Whse.	1200	120/240	440/224
1	8	G.E.	1750	250	440/224

1 25-KW., 450-V., 3-PH., 60-CY. Dir. Conn. 40-H.P., 230-VDC, 1800 RPM motor.
(1—2½ K.W., 440-V., 3-PH., 60-CY., Dir. Conn. 5.5-HP., 230-VDC., 1800-RPM motor.

DIRECT CURRENT MOTORS

Qu.	H.P.	Make	Type	R.P.M.
1****	2500	G.E.	MCP-14	200/400
4****	1500	White	Excl.	600
2****	1250	Whse.	Mill	300/600
1****	800	Whse.	Excl.	600
1	500	G.E.	MDC	165/330
1	400	Al. Ch.	MUC	400/1200
1	350	G.E.	C.D. 169	1150
1***	350	G.E.	MCF-4	240/600
1	325	Whse.	Q.M.	450/900
1	200/250	El. Dy.	F-22	400/1200
1	200	Whse.	Mill	300/1200
1	180	G.E.	MPC	400
2*	150	Cr. Wh.	83-M	800
1	100/125	Reliance	1995-F	300/1200
2	100	Reliance	1050-T	400/1200
1	75	Whse.	1995-F	300/1200
1**	50/75	Reliance	151-L	400/1200
1*	30/75	Whse.	151-L	400/1200
1	50	Whse.	SK	300/1200
1	35	Whse.	SK-140	500/1500
1	32½	Whse.	SK-150	400/1200
1	30	G.E.	CD-105	875/1750
1	25	G.E.	RF-13	400/1600
1	25	G.E.	RF-13	400/1200
1	25	Whse.	SK-NIL	250/1600

Above are all 230-VDC except where marked ***
****Pedestal Bearing 525/600-VDC. Mill Type—T.E.F.C.

T. B. MAC CABE COMPANY

614 CLARISSA STREET PHILADELPHIA, PENNA.

Most all units still on foundation. Many may be seen operating

TURBO. GENERATOR UNITS

1500 KW. GE generator only; 2300 V.
1500 KW. GE Turbo only; Non-Cond.
1250 KW. (2) Al. Chal., Cond.
1000 KW. (2) Elliott Condensing-Bleeder 3/60/480 V.
625 KW. Wghse., Cond.
500 KW. GE 2300 V. Non-Cond.
500 KW. GE 3/60/2400/4160 V—Murray, Cond.
250 KVA. Al. Chal. 240/480 V. Non-Cond.
250 KVA. GE 3-60-600 V. Non-Cond.
ALSO TURBO UNITS; NON-CONDENSING & CONDENSING; from 50 KW. to 2500 KW.

BOILERS

540 HP. Keeler, Heine type 250#
509 HP. B&W Sterling 450#
400 HP. Erie City Heine type 200#
285 HP. B&W 3 drum, type H 250#
250 HP. (2) B&W 3 drum, type H 200#
250 HP. (2) B&W 3 drum, type H 250#

STEAM ENGINE SETS A.C.

825 KVA GE-Hamilton corliss
750 KVA Wghse.-Skinner Uniflow
500 KVA GE-Skinner Uniflow
450 KVA GE-Chuse 4 V.
312 KVA GE-Chuse 4 V.
312 KVA (2) GE-Skinner Uniflow
187 KVA Wghse.-Ames Uniflow, *Vertical*
62 KVA GE-Ames Uniflow

DIESEL UNITS A.C.

1225 KVA Fairbanks Morse, 7 cyl., 300 RPM
1250 KVA (2) GE-Superior, 8 cyl., 360 RPM
250 KVA (2) GE-Buckeye 8 cyl.
109 KVA GE-Superior 3 cyl.
106 KVA GE-Murphy 6 cyl., *Portable*
100 KVA GE-Buckeye 5 cyl.
90 KVA Fairbanks Model 32
75 KVA (2) General Motors; *Portable*
225 HP. Buckeye 6 cyl. diesel engine only
ALL SIZES UP TO 1250 KVA

COMPRESSORS

850 CFM (2) 110 lbs., Chicago Pneumatic, *diesel driven*
ALSO ALL SIZES 150 CFM to 1000 CFM.

PUMPS (Motor & Turbine Driven)

From 200 to 2500 GPM; from 200 to 2500' hds.
CORLISS ENGINE — 18x36 Allis Chalmers
TRANSFORMERS—MOTOR GENERATOR SETS

Above listed units are only a few of our "SPECIALS". Advise your plant requirements.

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt St.
New York, N. Y.

OPPORTUNITY - BEFORE DISMANTLING -

A COMPLETE POWERHOUSE

INCLUDING:

BOILERS
2—1300 HP

TURBO GENERATORS
1—3750 KVA
1—1000 KVA
2— 625 KVA
1— 500 KVA
(all WESTINGHOUSE 3 phase, 60 cycle)

AIR COMPRESSORS
Large—steam and motor driven, with Hydraulic Pumps

TRANSFORMERS
3750 KVA and down

PUMPS
Large assortment steam and motor driven

VALVES AND PIPING
Large assortment—NEW *and allied equipment*

LOCATION—Pittsburgh District

Act Quickly! Dismantling Will Commence within 30 Days!

FS-7221, POWER
520 N. Michigan Ave., Chicago 11, Ill.

Quick ANSWERS to your business problems . . .

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McGRAW-HILL PUBLISHING CO., Inc.

330 West 42nd Street
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FOR SALE

F. O. B. Jackson, Mississippi, on foundation, complete direct current power plant consisting of:

2 Skinner Universal Unaflow Engines
2 250 K. W. General Electric 240 Volt Generators
2 Balance Sets
1 Switch Board with circuit breakers and metering equipment.

E. BILL GREEN, *General Manager*

HOTEL EDWARDS
JACKSON, MISSISSIPPI

FOR SALE
GEARHEAD MOTORS

100—Westinghouse 2 HP, 157 RPM, 3/60/220/440, other sizes up to 15 HP.
Speed Reducers from 3:1 to 1080:1 and up to 30 HP.

SURPLUS & SALVAGE CO., INC.
620 W. 8th St., Jamestown, N. Y.

FOR SALE

3 used I-R; 12x12x12 duplex double acting Imperial type 10; 250 RPM 50 lb. belt driven air compressors belt wheel 5 ft. diameter.

1 Used D.C. Motor 65 HP 110 v. compound wound, 500 RPM, newly reconditioned.

FS-7139, POWER
330 W. 42nd St., New York 18, N. Y.

CRANE MOTORS

(5) GE MD107 ..... $1,000.00 EA.

WINSTON MACHINERY CO., INC.
517 South Delaware St. Indianapolis 4, Ind.

UNUSED STAR ELECTRIC M-G SET

SYN. MOTOR: 150 HP 3/60/220-440 Volt/1200 RPM/.8 P.F. Type GN-95
GENERATOR: 100 KW DC 240 Volt Cpd. wound. Type SG-94 Ser. #5B649-G.
THE ABOVE M-G SET IS 2 BRG. BALL BEARING WITH A DIRECT CONNECTED EXCITER.

ALBERT HELLER CO.
210 Snediker Ave. HY 4-8400 Bklyn 7, N. Y.

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
600	2300	G.E.	1800
500	2300	G.E.	450
450	440/220	Whse.	514
350	2200/440	Whse.	600
300	440/220	Whse.	900
300	2300/440	G.E.	1200
300	440	G.E.	450
150	440/220	Whse.	600
150	440/220	Whse. (2)	1800
150	2200/440	G.E.	1200
150	440/220	G.E.	720
100	440/220	G.E.	600
100 (2)	440/220	Whse.	900
100	2200/550	G.E.	1800
30	440/220	G.E. (MTC)	900
75	2300/550	G.E.	1800

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2200/440	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
250	4000/2300	W. Mchy.	Sync.	600
240	2300/440	G.E.	ATI	720
200	440/220	G.E.	TS	720
200	4150/2100	Whse.	G	1800
200	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

GENERATOR SETS

1—62½ kva. 1200 rpm. 220 volt. Whse., geared to 7300 rpm. Whse., non-cond. steam turbine, 150 lbs. pr.
2—unused 25 kva. 120/240 v., 3 ph., 1200 rpm. generator dir. conn. to Waukesha 6 cyl. gas engine

TURBO-GENERATOR

Generator, 62½ kva. 1200 rpm. 440/220 V., Whse., geared to 50 kw, 7300 rpm. non-condensing.

CIRCUIT BREAKERS

2—2000 amp., GS E. 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse., 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
650	440	G.E.	FT	1800
500	2200	Cr. Wh.	SC	1800
500	440/220	G.E.	IK	900
350	2300	G.E.	KT	1200
300	2200	G.E.	FT	1800
300	2200	G.E.	KT	1200
250	2200/440	L. Allis	OGS	1200
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1180
200	440/220	G.E.	KT	1200
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
200	440/220	G.E.	IK	450
150	440/220	G.E.	IK	450
100	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1200
150 vert.	440/220	G.E.	KTP	1200
150	440/220	G.E.	IK	514
150	440/220	Whse.	CS (NEW)	900
100	2200/440	G.E.	K	1200

A. C. GENERATORS

1—320 kva.	660 rpm.	2300/440/220 V., G.E.	
1—250 kva.	720 rpm.	2300/440 v., G.E.	
1—225 kva.	600 rpm.	220/440 v., G.E.	
1—225 kva.	720 rpm.	2300/440 v., G.E.	
1—150 kva.	900 rpm.	480/240 v., G.E.	
3— 75 kva.	1800 rpm.	480/240 v., Whse.	

D. C. MOTORS

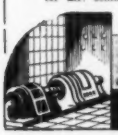
HP	Volts	Make	Type	Speed
350	230 (3)	G.E.	CD	1150
250	230 (3 new)	Cr. Wh.	CMC	1800
200	230	Cr. Wh.	CMC	900
200	230	Cr. Wh.	CMC	600
150	230 (new)	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
100	230	G.E.	CD	1150
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—800 kw, 1200 rpm. 250 v., G.E., connected to 500 hp. 1200 rpm. 2300/440 v., synchronous
1—125 kw, 1200 rpm. 240 v., G.E., conn. to 250 hp. 1200 rpm. 440/220 v., squirrel cage
1—100 kw, 250 v., Hertner, 1200 rpm, connected to 150 hp. 2300/440 v., synchronous
1—90 kw, 1200 rpm. 250 V., G.E., connected to 135 hp 2200/440 V. squirrel cage motor
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp. 2200/440 v., syn. motor.
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp. 440/220 V., sq. cage

TRANSFORMERS 60 Cy.

3—667 kva. Whse., 33,000—2300 Y.
3—333 kva. G.E., 13,200—2300 V
3—333 kva. Whse., 2400—480/240 V., Dry
3—250 kva. G.E., 6900/13,800—230/460 V.
3—250 kva. Whse., 11,000/22,000—2300 V.
3—250 kva., Whse., 2300—208 V.
3—200 kva. Whse., 13,200—2300 V. (Inerteen)
6—150 kva. Al. Chal. 2400—240/120 v.
1—150 kva. Whse. SK. 13200-133/215 v., 3 ph
3—100 kva. G.E., 4600/2300—230/460 V.
3—100 kva. G.E., 13800—230/115 v., NEW
6—100 kva. G.E., 4600/2300-230/115 v., NEW
3—100 kva. G.E., 450-115/230 v., dry, 1 ph, new
3—75 Kva. G.E., 480—240/120 v. Pyranol
3—50 kva. G.E., 480—240/120 V., Pyr



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SINCE 1912 CINCINNATI 27, OHIO

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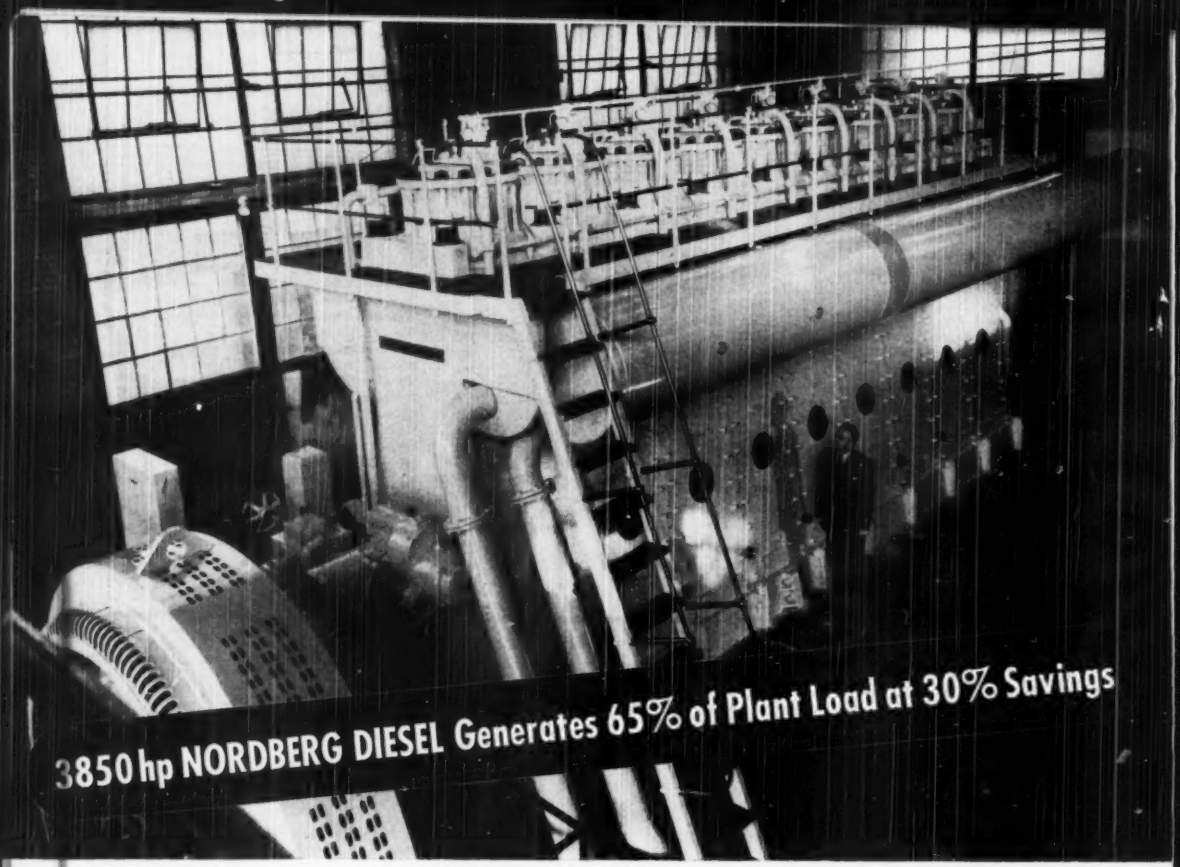

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P550

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- LONG FLEX-LIFE
- HIGH SHOCK-LOAD RESISTANCE
- COOL RUNNING
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- RESISTS AGING
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- MILDEW RESISTANCE

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